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AN UNUSUAL DISEASE OF HONEY BEES[1]

By ELMER G. CARR

An unusual disease of honey bees appeared in an alarming manner in some well kept apiaries in New Jersey and many other states and in Canada the past season (1917). This was not the first appearance of this disorder in the state and it is entirely possible that the same trouble may have appeared in the apiaries of the less observant beekeepers, many times previous to this date. This trouble was first brought to the notice of the department of apiary inspection in June, 1915.

Mr. Charles Schilke of Morganville, Monmouth County, a beekeeper with considerable experience operating about 300 colonies reported a great loss of bees from the hives in one of his yards located near Bradevelt. Thousands of dead were lying and thousands of dying bees were crawling about in the vicinity of the hives, collecting in groups on bits of wood, on stones and in depressions in the earth. The affected bees appeared to be practically all young adult workers about the age when they would normally do the first field work, but all ages of older bees were found. No abnormal condition within the hive was noticed at this time. The brood appeared normal except for quantity.

The apiary was located in a grove of small trees and the hives were quite thoroughly shaded. The stock was good Italians moved the preceding spring from the home apiary a few miles distant. Poisoning was suspected but no definite conclusions were reached. There is no record of the local meteorological conditions at or immediately preceding this time.

[1] This and the following paper were read at the Pittsburg meeting. They were received too late for insertion in the published proceedings.—ED.

The trouble soon ceased but not until it had taken such a number of bees that the apiary was made profitless. Mr. Schilke thought the trouble came from the water supply, either through dew from sprayed plants or from a contaminated watering place. This apiary was moved to another location.

The following season Mr. Schilke's home apiary at Morganville was similarly affected. An investigation was made but nothing new was learned.

Early in July of the past season a report was received that an apiary of twenty-five colonies at Milhurst, operated by Mr. Schilke, was rapidly being decimated by what appeared to be the same trouble that had before been seen.

On July 12th an investigation of this trouble was made by Dr. Headlee, State Entomologist, New Brunswick, Dr. Sturtevant of the Bee Culture Laboratory, Washington, and the writer.

The apiary was located in an orchard of old high trees which partially shaded the hives although there was opportunity for a free circulation of air. The stock was hybrids.

The ground in the vicinity of the hives was covered with thousands of dead and sick bees. Some were feebly moving about, their movements being much like those exhibited by bees benumbed by cold. Others were more active and displayed a nervous haste to get away from the hive but their progress was slow. The dead were distributed all over the ground, no more being immediately in front of the hive than in any other direction from the hive. While there were a very few of the older workers noticed affected, almost all were young bright looking adults apparently about the age when they would take their first flights. While their abdomens were plump as is quite usual with young workers there was noticed little or no undue distention of the abdomen. Neither were any hairless or shiny bees seen.

The bees showed a tendency to collect in groups not only in depressions in the earth which might be due to feebleness but also on slightly elevated objects such as bits of wood and stones. There was also a decided tendency for these groups to be arranged so that the bees faced each other and many were seen touching tongues. Many bees were seen to make vain attempts at flight.

When the affected bees were bursted the abdominal contents were found watery and gave off an unpleasant somewhat pungent odor entirely unlike that coming from a bursted healthy bee. Not only were workers affected by this trouble but also drones and Mr. Schilke claimed that he had seen queens similarly affected.

The brood within the hives appeared to be healthy.

In contradistinction to the bee disorder commonly known as paral-

ysis, in very few cases was there observed any unusual distention of the abdomen. Neither were there hairless or trembling bees noticed nor were the dead bees massed in front of the hive as is usual in paralytic bees. An abnormal condition noticed in the hives was the great abundance of stored pollen and the unusually small amount of unsealed honey in the combs. In some hives the stored pollen amounted to as much as two combs full.

An apiary of Mr. Schilke less than two miles distant located in the full sunlight was only slightly affected.

The apiary of Mr. J. Kridel, less than one mile from the badly affected apiary, in the shade, was also badly affected. The conditions within the hives were practically the same, *i. e.*, a superabundance of pollen and an unusually small amount of unsealed honey. Dead bees from the ground were examined for arsenic with negative results.

The apiary of Mr. J. Errickson in Freehold, four miles from the Schilke and Kridel apiaries, hybrid bees, located in the shade was similarly affected. Mr. Errickson noticed that many bees after repeated attempts succeeded in flying.

Many apiaries in this vicinity were examined, some containing hybrid bees, some Italian, in the shade and fully exposed to the sunlight and all were found more or less affected.

This disease appeared coincidently with a period of "dull" weather when the bees gathered an usual amount of pollen and little or no nectar. With the coming of fair weather the disease disappeared but not until the colonies were so depleted as to be of no value as surplus honey producers. Aside from the bees in this vicinity covering an area not more than seven miles in diameter no reports were received of a like trouble within the state.

From the evidence it was assumed that the bees were suffering from a digestive disturbance caused by a diet containing too large a proportion of nitrogenous matter. In support of this theory is the superabundance of pollen stored in the combs of the infected colonies, not only in these New Jersey apiaries but also in apiaries in New York, Ohio and Ontario, and the disappearance of the trouble upon the coming of weather favorable to nectar gathering. Antagonistic to this theory is the presence of sealed honey in the combs. Huber[1] says capped honey is never used in summer except in case of extreme necessity. If we may assume then that the bees show a great disinclination to uncap sealed honey at this season of the year the theory holds good.

[1] Huber, F., 1821, "New Observations on the Natural History of Bees," third edition—Edinburgh.

Just what relation the parasite *Nosema apis* may bear to this trouble is not yet proven, but the symptoms in bees affected by this trouble are strikingly similar to the described symptoms of Isle of Wight disease which has been thought to be caused by this parasite.

Imms[1] says "this parasite affects the digestive system and there is an enlargement of the posterior parts of the intestine particularly the colon and rectum" which appears to support the theory of defective digestion. He further says "beekeepers claim to prevent the occurrence of this disease by feeding." This further supports the theory.

The results of the studies of *Nosema apis* by Fantham and Porter[2] appear to coincide with the conditions accompanying this trouble. They state that "the virulence of the parasite (*Nosema apis*) appeared to vary in bees at different times of the year and in different locations." This possibly accounts for the manner in which this trouble appears at widely scattered points.

Fantham and Porter[3] have found *Nosema* in greatest numbers in the chyle stomach and in a lesser degree in the small intestines. The spore stage is the only stage they have proven capable of infecting new hosts.

The observations and experiments by Anderson and Rennie[4] apparently fail to connect *Nosema apis* in any causal relation with Isle of Wight disease. They were unable to convey the disease by contact with contaminated hives or combs or by feeding contaminated stores. They found spores of *Nosema apis* in bees showing no symptoms of disease and the examination of many bees showing the disease revealed no trace of *Nosema apis*. Their observations revealed, usually, only a small per cent of colonies in an apiary affected by disease and aside from one colony of what they called "American goldens," the disease affected one race as readily as another.

In the work at the Bee Culture Laboratory at Washington *Nosema apis* has been found in both sick and apparently healthy bees.

The observations of the various persons mentioned seems to leave considerable doubt as to *Nosema apis* being the cause of the disorder observed. The presence of *Nosema* in bees apparently healthy, might be explained by the work of Fantham and Porter who claim that some

[1] Imms, A. D. (Journ. Bd. Agric., London, 14 [1907], No. 3, pp. 129–140, fig. 3.)

[2] Fantham, H. B., and Porter, Annie. (Proc. Zoöl. Soc., London, 1911, III, pp. 625–626.)

[3] Fantham, H. B., and Porter, Annie, 1914, "Some Minute Animal Parasites," London.

[4] Anderson, J., and Rennie, J., 1915–1916, "Observations and Experiments Bearing on 'Isle of Wight' Disease in Hive Bees." Royal Phys. Soc. of Edinburgh, vol. XX, part I.

bees are themselves immune to the attacks of this parasite but act as carriers of the disease.

If *Nosema* is really the culprit, the failure to find the parasite in bees apparently suffering with Isle of Wight disease is not easily explained.

It is highly desirable that the exact cause for this serious bee trouble be discovered in order that its control be intelligently undertaken. However, until such a time as the cause is known it seems entirely practicable for beekeepers to correct, when possible, any abnormal or unfavorable conditions about the apiary and perhaps decrease if not entirely overcome the harmful effects of this disorder.

FOUL BROOD ERADICATION WORK IN TEXAS

By F. B. PADDOCK, *State Entomologist, College Station, Texas*

The law under which the foul brood eradication work is being conducted in Texas was passed by the state legislature in 1913. The more outstanding features of this law were discussed by Wilmon Newell[1] before this section at the twenty-sixth annual meeting of the Association. He says, "The result was a law which seems to cover the ground thoroughly and to provide for all contingencies which may reasonably be expected to occur." Under the authority of the law, regulations have been issued from time to time. These deal primarily with the counties in which the eradication work is being conducted, having for their chief aim the necessity for transferring all bees to removable frame hives, and the preventing of the shipment into such counties of any material possibly infected with any contagious bee disease.

The funds with which to carry out the provisions of the law are appropriated by the state legislature. The request for such funds is made by the director of the Experiment Station and this request has the support of the State Beekeepers' Association.

The plan of work is based upon county organizations which coöperate with the state entomologist. When a new county makes a request for work, they are urged to organize a County Beekeepers' Association, and they are given every assistance possible in perfecting such. Then the Association is asked to suggest from its number, three men, who, in their opinion, are capable to serve as county apiary inspector. An examination is then held for these men and the one best qualified to serve is appointed by the state entomologist, subject to the approval

[1] Essentials of a Good Apiary Inspection Law. Wilmon Newell, Jr. Eco. Ent. *VII*, 1, p. 92.

of the director of the Experiment Station and confirmation of the Board of Directors of the College. Sometimes not one of the number proves capable, in which case the County Association can again select from its number for another examination. It is felt that by this means the man best qualified is appointed on merit only. So far the most cordial relations have existed between the County Associations and the state entomologist, and the work of every inspector has been entirely agreeable to all concerned. The foul brood eradication work, by this method, becomes very largely a home industry, and a feeling is built up in each county that demands proper action by every one of the beekeepers. The Association is watching the results of the inspector and demanding action by some few beekeepers as much as is the state entomologist.

The inspectors are paid a per diem of four dollars and an allowance for conveyance. Many of the inspectors use their autos, and encouragement is given this plan, so more of the inspectors are purchasing cars. It is acknowledged that the work can be done more efficiently by the use of a car than by the use of a horse and buggy. The state entomologist is in touch with the inspectors throughout the entire year and they are required to submit a report each month even to show, "No Inspections." The system has developed so that the inspectors are called upon for information of one kind and another, such as general insect reports, honey flora conditions and locality crop reports.

There are now thirty-one quarantined counties in the state. This means that there are thirty-one counties into which no bees, honey or appliances possible of transmitting foul brood can be consigned without an Inspector's Certificate, or a statement from the state entomologist that such goods will be inspected upon their arrival at destination. There are now twenty-four inspectors working in these thirty-one counties.

The presence of the foul brood has been determined in the several counties where the eradication work is not being conducted. It is our hope that we may be able to organize the work in these counties during the coming year. Already the movement is on foot through the Associations where the work is now being conducted, to assist us in organizing the work in adjoining counties. In the past we have preferred to confine our efforts in the eradication work in those counties where the beekeepers were sufficiently interested in the work to organize and coöperate with us. We have had all that we could possibly do with funds available in the organized counties until this year.

The greatest handicap to the work is the ignorance and indifference among a certain class of beekeepers in almost every county in which the work is being conducted. It is expected that this indifferent class

will form a large proportion of the total beekeepers in the unorganized counties. The number of box hives in some of the counties where the inspection work is being conducted, is far too large. There are now a few counties in which no box hives can be found. While the law specifically states that no bees shall be kept in box hives, it seemed inadvisable to force transferring which would necessarily fill the county courts with cases of misdemeanor. We have preferred to take the slower plan of conducting an educational campaign on the value of removing all bees from box hives.

We have found that inspection work cannot go single handed; it must be accompanied with educational work. In two counties we have had especially good results from the campaigns conducted against box hives. In one county in three months 350 box hives out of 1000 had been transferred in movable frame hives. The beekeepers of every county where inspection work is now being conducted, are now realizing the value of the service of the inspector. In many cases the inspectors are receiving more requests for inspection work than they can possibly take care of. An inspector is now considered more than a police officer; he serves very often as an advisor.

The foul brood inspection service has been for the general improvement of the beekeeping industry of the state. We have received letters from all sections which indicate that there has been a general uplift of 50 to 75 per cent in the efficiency of the industry where the work is now being conducted. The inspection work has resulted in a state wide coöperation among beekeepers. In all sections of the state, the beekeepers have come to realize that inspection work is for a common good. Not only have the organizations expressed a desire to coöperate with the state entomologist at all times, but many individual beekeepers all over the state have sought to coöperate in any way possible. There are now very few intentional violations of the law or regulation. The greatest tendency is on the part of honey shippers to disregard the need of certificates in shipping honey. There are some counties where the inspection service is being rendered that do not have foul brood now, and by this action, they are seeking to prevent its introduction. In very few counties foul brood has been eliminated and in many more the disease will be stamped out in a very short time.

CALCIUM ARSENITE AND ARSENATE AS INSECTICIDES[1]

By E. B. HOLLAND, *Associate Chemist*, and J. P. BUCKLEY, *Assistant Chemist*, *Massachusetts Agricultural Experiment Station*

An intensive production of orchard and garden crops the present season will tend towards a maximum consumption of arsenicals in combating leaf-eating insects. A scarcity of lead arsenate, the standard "stomach poison" insecticide, or a prevailing high price will undoubtedly bring into the market other cheaper and less reliable arsenicals such as calcium arsenite and calcium arsenate. The acknowledged requisites for an insecticide that is to be applied as a spray are: non-toxicity as to plant, effectiveness in destroying the insect, adhesiveness or persistence under weather conditions, fineness of particles and low specific gravity to insure a high power of suspension and uniform distribution, ability to indicate the leaf surface covered, and reasonable cost. All arsenical compounds are poisonous, although as a rule the lower or "ite" salts are more active than the higher or "ate" salts. Arsenic soluble in water or which has been rendered soluble by atmospheric agents has a corrosive (burning) action on foliage to the extent of entire defoliation of the plant in severe cases. Therefore an arsenical must be insoluble and stable in water or in whatever vehicle employed to insure its safe application.

Pure calcium arsenite, $Ca(AsO_2)_2$, is a white powder, fairly soluble in water but practically insoluble in presence of excess lime, and contains 77.92 per cent arsenic trioxide. As a farm preparation it was formerly used considerably in the central and western portions of the United States, but recently it has appeared in eastern markets in the form of paste under a trade name. Some years ago Holland and Reed[2] prepared the pure salt and determined its formula and solubility. Spraying tests by the Department of Entomology of this institution showed that it is likely to cause some injury even when mixed with strong (3 per cent) milk of lime. Similar results might be expected when applied with Bordeaux. Calcium arsenite with excess lime has a good power of suspension, the white film readily indicates the leaf surface covered and its adhesiveness provides protection for a reasonable period under average weather conditions. Pure sodium arsenite is a white powder, very soluble in water and contains 76.15 per cent arsenic trioxide. Although offered on the market in solution under a

[1] From the Department of Chemistry, Massachusetts Agricultural Experiment Station. Printed with the permission of the Director of the Station.

[2] 1912, The Chemistry of Arsenical Insecticides. In Mass. Agr. Expt. Sta., Rpt. 24, pp. 194-201.

trade name, its solubility precludes its direct use as a spray but it may serve for the preparation of calcium arsenite by mixing with milk of lime or Bordeaux as directed by the venders. Its use by inexperienced persons cannot be recommended.

Calcium arsenate is manufactured by a number of firms and some experiments have been reported relative to its efficiency. In order to secure more definite information on the subject the Department of Chemistry undertook the preparation of one or more pure salts of calcium and arsenic acid for experimental use by the Department of Entomology. By analogy one might assume that three salts of calcium and of arsenic acid were possible,—the tricalcium, the dicalcium and the monocalcium arsenates as in the case of the phosphates; or at least two salts,—the so-called neutral (tricalcium) and acid (dicalcium) arsenates as in case of lead and arsenic acid. The acid lead arsenate having proved very satisfactory, attention was directed chiefly to the preparation of a similar calcium salt. Precipitation of calcium arsenate from soluble salts of calcium and of arsenic promised the most definite and uniform product as the resulting compound is not recrystallizable. Calcium chloride, neutral and free from other bases forming insoluble arsenates, proved a satisfactory source of calcium (preferable to the acetate), and disodium arsenate, free from arsenite, carbonate and sulfate, a reliable source of arsenic. Previous experience with calcium arsenite indicated that the degree of concentration of the solutions would be a factor in the preparation of the arsenate; unnecessary dilution tends to make difficult precipitation with considerable loss of salt, and too great concentration an unwieldy precipitate with greater occlusion. One-half molecular (M/2) and molecular (M) strength solutions appeared feasible considering the solubility and amount of active agent in each salt, but after considerable preliminary work molecular solutions were found preferable.

Acid calcium arsenate precipitated in the cold from the chloride by an excess (10 per cent) of sodium arsenate generally carries an excess of calcium probably due to the alkalinity of the sodium arsenate and to the failure of the arsenic acid to readily unite with the lime. Heat facilitates the interchange of bases, and arsenic in neutral form is preferable for the excess. Monosodium arsenate is neutral and can be easily prepared from a solution of the disodium by adding the calculated amount of hydrochloric acid. Under these conditions the following reaction may be said to take place:

$$CaCl_2 . n H_2O + Na_2HAsO_4 . 7H_2O + NaH_2AsO_4 = CaHAsO_4 . H_2O + 2NaCl + n H_2O$$

equal volumes of M solutions 10% excess

The mixed solutions were heated slowly to 95° C. with agitation, al-

lowed to cool, filtered in a Büchner funnel, washed free from chloride, dried at a low temperature, and weighed. In laboratory practice the recovery on the basis of the original calcium content averaged nearly

ANALYSES OF ACID CALCIUM ARSENATE

	No. 12		No. H 1–7		Theoretical $CaHAsO_4.H_2O$
Character of product	dry powder		dry powder		
Color	white		white		
Shape of particles	rhombic crystals[1]		rhombic crystals[1]		
Size—length[2]	5–32μ av. 19μ		4–28μ av. 17μ		
breadth[2]	2–11μ av. 6μ		2–16μ av. 9μ		
Uniformity[2]	variable in shape and size		variable in size		
Nature of defects[2]	broken crystals		broken crystals		
Amount of defects[2]	50 per cent		1 per cent		
	Air dry, per cent	On dry basis, per cent	Air dry, per cent	On dry basis, per cent	Per cent
Water	.20		.12		
Calcium oxide (CaO)	28.25	28.306	28.30	28.334	28.310
Arsenic pentoxide (As_2O_5)	57.91	58.026	57.955	58.025	58.045
Water of combination	13.65	13.676	13.63	13.646	13.645
	100.01	100.008	100.005	100.005	100.000
Arsenic (As)		37.836		37.835	37.848

[1] For description see Gmelin-Kraut's Handbuch der anorganischen Chemie, Bd. 3, Abt. 2, pp. 568–569 (1908).

[2] Determined by A. I. Bourne of the Entomology Department.

SOLUBILITY OF ACID CALCIUM ARSENATE

	No. 12 per cent	No. H 1-7 per cent
Water	.20	.12
Water soluble (Hilgard method)		
Calcium oxide		22.50
Arsenic pentoxide	50.52	44.82
Solids		74.20
Lime water soluble		
Arsenic pentoxide	.31	.17

86 per cent in spite of innumerable mechanical losses. Attention is called to the analyses of two samples of acid arsenate. No. 12 was produced in the preliminary work and No. H 1–7 drawn from a mixture of seven different laboratory batches prepared for spraying experiments.

Acid calcium arsenate is soluble in water but practically insoluble in lime water, which indicates that its safe application necessitates an admixture with Bordeaux or strong milk of lime. It contains a high percentage of arsenic and may serve in many instances as a substitute for acid lead arsenate during the present emergency. Experiments to test its efficiency are in progress.

FUMIGATION WITH CHLORPICRIN[1]

By WILLIAM MOORE, *Division of Entomology and Economic Zoölogy, Minnesota Agricultural Experiment Station*

INTRODUCTION

The discovery that chlorpicrin, although a rather volatile compound,[2] is extremely toxic to insects naturally raised the question as to its possible use in the fumigation of grain and clothing. Its value as a fumigant to destroy the clothes louse [*Pediculus humanus (vestimenti)*] and its eggs has been reported.[3] Molecule for molecule it is about 283 times as toxic as carbon bisulphide, which is now in common use as a fumigant of clothing and grain. Carbon bisulphide has the disadvantage of being very explosive. The use of chlorpicrin under normal conditions is without danger, although when heated it may be exploded. Carbon bisulphide, although it has a very disagreeable odor, does not deter people from entering a room containing large quantities of the vapor, and illness and even death may result.

Owing to the severe irritation to the eyes, nose, and throat produced by even very small quantities of the vapor of chlorpicrin in the air, no one would ever enter a room until all the vapor had escaped. One of the chief advantages of carbon bisulphide in the fumigation of grain is that its vapor is about 2.5 times heavier than air and is thus able to sink down through a large mass of grain. Chlorpicrin vapor is about twice as heavy as that of carbon bisulphide. With these advantages in mind the following experiments are of interest.

[1] Published, with the approval of the director, as paper No. 114 of the Journal Series of the Minnesota Agricultural Experiment Station.

[2] Moore, Wm., Volatility of Organic Compounds as an Index of the Toxicity of their Vapors to Insects, Jour. of Agr. Research, vol. X, No. 7, 1917, pp. 365–371.

[3] Moore, Wm., The Control of the Clothes Louse [Pediculus humanus (vestimenti)], Jour. of Lab. & Clin. Medicine, vol. III, No. 5, 1918, pp. 261–268.

Effect of Fumigation on Insects Infesting Grain

Exp. 1. Ears of corn infested with adult saw-toothed grain beetle (*Silvanus surinamensis* Linn.) and pupæ of the Indian meal moth (*Plodia interpunctella* Hbn.) fumigated with chlorpicrin at the rate of one-half pound per 1,000 cubic feet under a bell jar for twenty-four hours at a temperature of 70°–80° F. Insects killed.

Exp. 2. Flour infested with adult confused flour beetle (*Tribolium confusum* Duval) was placed in a battery jar to a depth of three inches. Fumigated under bell jar at rate of one-half pound of chlorpicrin to 1,000 cubic feet for twenty-four hours at a temperature of 72° F. Beetles all killed.

Exp. 3. Flour infested with larvæ and adults of confused flour beetle fumigated as in preceding experiment, but using one pound of chlorpicrin per 1,000 cubic feet for twenty-four hours, temperature 72° F. Adult beetles were killed, but all the larvæ were still alive.

Exp. 4. Corn meal infested with larvæ of Mediterranean flour moth (*Ephestia kuehniella* Zell.) placed in paper flour bag. Flour infested with adult confused flour beetle contained in a battery jar to the depth of five inches. Corn on the ear infested with saw-toothed grain beetle. All fumigated in a wooden box of six cubic feet capacity for twenty-four hours at a temperature of 70° F. using chlorpicrin at the rate of one-half pound per 1,000 cubic feet. Mediterranean flour moth and the adult saw-toothed grain beetles all dead. Confused flour beetles, buried in the flour, survived the fumigation.

Exp. 5. Beans infested with larvæ, pupæ and adults of the bean weevil (*Bruchus obtectus* Say); whole wheat flour with cocoons of Mediterranean flour moth and white flour with all stages of the confused flour beetle. Each was contained in paper bags which were placed in the wooden fumigation box and fumigated with one pound of chlorpicrin per 1,000 cubic feet of space for twenty-four hours at a temperature of 70° F. All the insects were killed.

Exp. 6. Beans infested with larvæ, pupæ and adults of the bean weevil were fumigated as in the preceding experiment, but using one-half pound of chlorpicrin for each 1,000 cubic feet. All insects destroyed.

Exp. 7. Twenty-five and fifty pound sacks of flour infested with all stages of the confused flour beetle were placed in different parts, some near the top, others at the bottom of a wooden fumigation box of 180 cubic feet capacity. These were fumigated with chlorpicrin at the rate of one pound per 1,000 cubic feet for twenty-four hours at a temperature of 70°–75° F. Flour was thoroughly aired and then sifted and the insects examined. They were then placed in the open and reëxamined twenty-four hours later. Both examinations failed to reveal a single live insect. Some of the flour was kept for three months, but no insects developed in it.

Exp. 8. Ears of corn infested with larvæ, pupæ and adults of the Angumois grain moth (*Sitotroga cerealella* Oliv.) were fumigated in the wooden box of six cubic feet capacity with chlorpicrin at the rate of one-half pound per 1,000 cubic feet at a temperature of 55° to 61° F. for twenty-four hours. After thorough airing, examination of the ears showed only dead larvæ, pupæ and adults. The ears were kept for two months and since no further evidence of the moth could be detected 100 per cent must have been killed.

Exp. 9. Beans infested with the bean weevil larvæ, pupæ and adults, and flour infested with confused flour beetle were fumigated in fumigation box of six cubic feet capacity for twenty-one hours at the rate of one-half pound per 1,000 cubic feet. Temperature during fumigation 65°–70° F. All stages of the bean weevil were killed, but the flour beetles deeper than from one and one-half to two inches in the flour survived.

Exp. 10. Flour infested with larvæ and adults of the confused flour beetle contained in a flat glass dish one and one-half inches deep, and beans infested with the bean weevil, contained in a battery jar, were fumigated in the fumigation box of six cubic feet capacity for forty-eight hours with carbon bisulphide at the rate of three pounds to 1,000 cubic feet. Examination after airing showed all the larvæ and adult of the confused flour beetle to be dead, while 100 beans contained one living larva and one adult out of thirty. The temperature during the experiment was 60°–68° F.

From these results it is apparent that one-half pound of chlorpicrin per 1,000 cubic feet will prove destructive to the bean weevil (*Bruchus obtectus* Say), the Angumois grain moth (*Sitotroga cerealella* Oliv.), the Indian meal moth (*Plodia interpunctella* Hbn.), Mediterranean flour moth (*Ephestia kuehniella* Zell.), but is not sufficient to kill the confused flour beetle (*Tribolium confusum* Duval) deeper than an inch in the flour. For this insect it is necessary to use as much as one or two pounds per 1,000 cubic feet. Where the quantity of flour or grain fills the entire space of the fumigation box stronger doses would be necessary. Carbon bisulphide must be used in our fumigation boxes at the rate of from three to eight pounds to produce similar results and the temperature must be above 65° F. In using chlorpicrin the temperature may be below 60° F. and still give good results as in Experiment 8.

Effect of Chlorpicrin on the Germination of the Grain

Table I summarizes the results of the effect of chlorpicrin on the germination of the grain.[1]

Table I

Seed	Check	24 hrs. 2 lbs.	24 hrs. 1½ lbs.	24 hrs. 1 lb.	24 hrs. ½ lb.	48 hrs. ½ lb.
		Each per 1,000 cubic feet				
Rye	82	67				
Oats	82	59				
Wheat	94	90				
Barley	99	98				
Corn	93	95				
Oats	99				97	
Oats	99			97		
Oats	99	93				
Rye	79	30		71		
Corn	90			95	98	
Corn	90	96	95			
Corn	93					92
Wheat[2]	88	60	66	72	81	64
Oats	94	93	95	96	98	92
Rye	99	89	95	96	99	87
Corn	90	96	95	95	98	
Corn	93					92

[1] I wish to thank Mr. Robert Dahlberg of the Division of Plant Pathology and Botany who kindly conducted the germination tests of the grain.

[2] This wheat was a poor grade having been injured by mice.

Small doses such as one-half pound per 1,000 cubic feet of space do not injure the germination of the grain. Large doses do injure the germination if germination is attempted before the grain has had a very thorough airing. Rye with a germination of 99 per cent was fumigated at the rate of two pounds per 1,000 cubic feet for twenty-five hours. A germination test started eight hours after being removed from the box gave 81 per cent; twenty-four hours, 81 per cent; forty-eight hours, 95 per cent; seventy-two hours, 98 per cent. It is also essential that the grain be perfectly dry when fumigated. Navy beans taken directly from the field before thoroughly drying were fumigated at the rate of two pounds per 1,000 cubic feet for twenty-four hours. The fumigated beans and the check were then permitted to thoroughly dry after which their germination was tested. The check germinated 95 per cent while the fumigated beans germinated 5 per cent. Part of the check after drying, similarly fumigated, germinated 94 per cent.

Effect of Chlorpicrin on Flour

In the earlier experiments fumigation with chlorpicrin had a bleaching effect upon flour. When pure chlorpicrin, free from chlorine and nitrogen peroxide, was used, however, no bleaching resulted. Samples of wheat fumigated and unfumigated were converted into flour and it was found that even following the use of chlorpicrin containing the above mentioned impurities no effect was noticed in the color of the flour.

A sample of flour was fumigated with chlorpicrin to test its baking properties. The fumigation was at the rate of two pounds to 1,000 cubic feet for twenty-four hours at 70° F. After fumigation the flour was thoroughly aired for a week after which it was enclosed in a tin box for a month before it was possible for the baking test to be conducted. The results are:

	Volume	Color	Texture	Expansion
Standard	1,520	100	99	820
Fumigated	1,450	100	96	850

The fumigated sample required thirty-five minutes longer for fermentation than the control. The chlorpicrin must either have had some action on the flour enzymes, or a small quantity of the chemical had been retained by the flour, resulting in an inhibition of the yeast, or it left the flour in such condition that the yeast was inhibited. The normal sample showed a water absorption of 58.18 per cent while the fumigated showed 62.40 per cent.[1] The bread, showing no different

[1] The author wishes to express his thanks to Miss Cornelia Kennedy of the Division of Agricultural Biochemistry for the study of the baking qualities of the flour.

taste from the normal, was fed to guinea pigs, rabbits, rats and cats, which ate it and showed no effects.

From these results it is apparent that the chlorpicrin has an influence on the baking qualities of the flour. It would be inadvisable to use chlorpicrin on a large scale for the fumigation of flour, but there may be cases where its use would be advisable and where the insects would do more damage to the flour than the chlorpicrin.

Effect of Fumigation on Clothing

As no insects infesting clothing were available no data can be given of the action of chlorpicrin on these insects. Insects infesting clothing are no more difficult to kill than those infesting grain, hence chlorpicrin should prove effective against insects in clothing if used at the rate of from one to two pounds per 1,000 cubic feet of space.

An effort was made to determine if the action of chlorpicrin would injure different types of cloth or tend to bleach their color. The following list of materials[1] and their colors were fumigated:

1. Lavender	Unknown
2. Rose pink	Ratiné
3. Lavender	Marquisette
4. Blue striped	Silk striped voile
5. Flowered blue and pink	Windsor crêpe
6. Green	Silkine or silk mull
7. Rose	Serpentine crêpe
8. Pink	Mull
9. Brick red	Mull
10. Cerise	Mull
11. Lavender	Silk striped voile
12. Lavender	Flowered Windsor crêpe
13. Pale blue	Ratiné
14. Pale blue	Silk striped voile
15. Dark red	Mull
16. Pink	Unknown
17. Flowered	China silk
18. Gray	Poplin
19. White	Mull
20. Pale blue	Ratiné
21. Copenhagen blue	Palm Beach
22. Gray	Artificial silk and cotton Longtex
23. White	Rep or poplin
24. White	Windsor crêpe
25. Baby blue	Marquisette
26. Yellow pink	Marquisette
27. Pink	Lorraine tissue gingham

[1] The names of materials and their colors were kindly furnished by Miss Clara Brown of the Department of Home Economics.

The chlorpicrin available for the earlier experiments contained a small amount of chlorine and nitrogen peroxide. With this material a slight bleaching of No. 1 and No. 7 was noted. When chemically pure chlorpicrin was used at the rate of two pounds per 1,000 cubic feet no bleaching was observed. Chlorpicrin may, therefore, be used to fumigate clothing, providing it does not contain impurities of chlorine and nitrogen peroxide. Even with the impurities the bleaching was not so great as would result from the washing of either of these materials.

Conclusion

Chlorpicrin cannot, at the present time, be obtained on the market, but the writer has been assured, through correspondence with chemical firms, that after the war it will be possible to manufacture this chemical for about thirty cents a pound in large quantities. Even if retailing for from seventy-five cents to one dollar a pound it would be a cheaper fumigant than carbon bisulphide. These results are published in order that others may try out this interesting compound. Chlorpicrin is a very poisonous compound, hence care should be exercised in its use. Owing to its irritation to the eyes and nasal passages it could never be used on a large scale or where it would be difficult to remove the vapor after the fumigation. It may prove of value in the fumigation of small quantities of grain or seeds, samples of grain such as the agronomist wishes to preserve, for the destruction of ant nests or gophers, while light doses may prove of value for the destruction of mosquitoes in yellow fever regions.

The following points summarize the experiments:

1. Chlorpicrin used at the rate of from one-half pound to one pound to 1,000 cubic feet will destroy insects, which require from three to eight pounds of carbon bisulphide.

2. There is more likelihood of injury to germination than in the use of carbon bisulphide, but with normal doses, if the grain is dry and is thoroughly aired after fumigation, no injury results.

3. Chlorpicrin is able to penetrate through fifty pound sacks of flour in twenty-four hours at a temperature of 70° killing all the insects.

4. Chlorpicrin has a slight injurious influence on the baking qualities of flour.

5. Chlorpicrin free from impurities of chlorine and nitrogen peroxide will injure neither dress materials nor their color.

NOTES ON THE POISONOUS URTICATING SPINES OF HEMILEUCA OLIVIÆ LARVÆ[1]

By D. J. CAFFREY, *Scientific Assistant, Cereal and Forage Insect Investigations, Bureau of Entomology*

INTRODUCTION

While making a preliminary study on the New Mexico range caterpillar (*Hemileuca oliviæ* Ckll.), Mr. C. N. Ainslie[2] noted that the larvæ were clothed with urticating spines, apparently as a means of protection against some of their natural enemies. Since his observations were made and during the course of further work on the control of this caterpillar, some interesting and important points have been observed concerning the poisonous effects of these spines borne by the larvæ of this species.

LOCATION AND DISPERSION OF SPINES

The urticating spines are borne in clusters along the subdorsal portion of segments 3 and 4 (mesothorax and metathorax) in the second and third instars, and in clusters along the sub-dorsal, lateral and subventral portions of segments 2 to 12 in the remaining instars. Although the spines are first developed in the second instar, their presence is not particularly noticeable until the fourth instar is reached. During the fourth and succeeding instars, it is very difficult for a susceptible person to come into contact with the larvæ without becoming painfully injured. The same is true of the pupæ and cocoons, as the urticating spines from the last moulted skin of the larvæ apparently are caught in the silken threads of the cocoon during the process of pupation, thus rendering these objects almost as difficult to handle as the larvæ.

ACCUMULATIVE NATURE OF THE POISONOUS AGENT

A notable fact, concerning the poisonous substance contained in the urticating spines, was that during the first season, the large *H. oliviæ* larvæ could be handled with safety by most persons starting in to work with the species. After a short time, however, and generally during the second summer of work, it became impossible for these same persons to handle *H. oliviæ* larvæ, which had advanced beyond the fourth instar, without the protection of gloves. It was a common occurrence for the new men to ridicule the more experienced workers for wearing

[1] Published by permission of the Secretary of Agriculture.

[2] Ainslie, C. N., U. S. Dept. of Agr., Bureau of Ent., Bulletin 85, Part V—The New Mexico Range Caterpillar—pp. 76–77.

gloves, but during an association with about ten different individuals, the writer never has observed an instance when complete immunity from the poisonous effects of the spines extended through the second season of work. It thus will be noted that the effect of the poisonous substance, contained in these urticating spines, appears to be accumulative rather than to cause any degree of individual immunity by continual contact with the poison. This characteristic is very similar to that occurring in the case of the Brown Tail Moth (*Euproctis chrysorrhœa*).

Character of Injury

The character of the injury caused by the urticating spines of *H. oliviæ* may be either external or internal.

External Injury. The most common external injury is that which is inflicted upon the tender portions of the tissue immediately surrounding the finger nails. The larvæ appear to fully appreciate the value of the spines as a means of defense, for when grasped in the fingers, they immediately begin to twist their bodies convulsively with the apparent object of driving the spines into the flesh. When this result is accomplished, the wounded portion is first affected by an intense itching and smarting, soon followed by a white swelling. This swelling remains for several hours and then usually subsides, only to return, accompanied by the same intense itching each time this portion of the skin comes in contact with any object. Apparently each time the wounded part is touched or irritated, the poisonous agent is stimulated into activity. The tough skin at the ends of the fingers is more resistant than any other exposed part of the body, but when once penetrated, an exceedingly painful wound is made, although only a minimum amount of swelling results. It often was necessary to transfer men, who had suffered such injury from the effects of these spines, to other work until the effects of the poison subsided.

The most painful and pronounced injury occurs when the large larvæ come into contact with the tender skin on the back of the hand, on the fore-arms, ankles or other unprotected parts of the body. On one occasion, the writer had the misfortune to bring the back of the right hand directly down upon a large sixth instar larva which was crawling along one of the insectary benches: an intense itching and smarting at once began, followed by a pronounced swelling. This did not subside, as is ordinarily the case, and the next morning the swelling had extended to the wrist; the entire hand being about one-half larger than normal, the knuckles appearing as sunken pits, and the surface of the hand smooth and shiny. A sort of numbness and dull pain was felt throughout the member, there being, however, no sensation of itching or smarting. A physician was consulted who applied strong

tincture of iodine in a band around the wrist, also painted the entire back of the hand with a weaker tincture of the same chemical. This treatment had the effect of arresting the swelling. The spot where the larval spines had entered the flesh became septic, due perhaps to the blistering effects of the iodine used, and the hand did not return to normal for more than a week.

Another instance showing the extremely active effects of the poison may be cited in the case of a man who climbed from the seat of his automobile in order to open a gate between two range pastures, which were infested with larvæ of *H. oliviæ*. This man happened to be wearing low shoes and thin socks, and probably brushed against a caterpillar clinging to a blade of grass. After returning to the automobile, he was conscious of a sharp stinging pain in his ankle, and upon removing the shoe and sock, observed a white swelling. He at once became very much alarmed and concluded that he had been bitten by a rattlesnake, as these reptiles are very numerous in this vicinity. It was only after an examination by a physician that he became convinced that he was not the victim of a snake bite.

During the course of investigations, many similar experiences of poisoning by *H. oliviæ* larvæ were related by the cattlemen and dry-land farmers who inhabit the infested region.

The eyes of the men working with the larvæ were often affected by the urticating spines, a severe inflammation and swelling being the usual result. This was probably due to the fact that the spines were either floating in the air or were carried to the eyes by the fingers or gloves which had become infested with the spines and were then carelessly used to rub the eyes.

Internal Injury. The internal injury caused by the urticating spines of *H. oliviæ* is of a much more serious nature than the external injury. While engaged in rearing predaceous beetles, it became necessary to collect and confine in screen-covered boxes large numbers of the larvæ of *H. oliviæ* to serve as food for these beetles. Five or six hundred larvæ were sometimes confined in a small box, and because of their constant crawling about and rubbing against each other, the urticating spines apparently became detached and floated in the air. While transferring this material or working in the vicinity of a cage containing the same, these spines often entered the respiratory tract during the process of breathing. The first effect of taking them into the system was an oft-repeated and painful sneezing, accompanied by an excessive watery discharge and soreness of the eyes and nasal passages. These symptoms rapidly developed into a condition worse than ordinary hay fever or bronchitis, the spines apparently irritating the bronchial tubes, rendering breathing

difficult and imparting a strong acrid taste to the mucous expelled. In more advanced cases, typical asthma resulted. At first these attacks were attributed to ordinary hay fever until it was noticed that the attacks continued long after the early frost had killed the flowers that are commonly blamed for this malady. Some individuals were affected more than others, but as a rule, those who had been working with the species for the longest period were affected the worst.

In attempting to recover pupal parasites, a great many pupæ, inside their cocoons, were collected each autumn and placed in paste board box cages, from which a glass vial protruded. From the pupæ not parasitized, adults often emerged and thrashed about inside the cage, instead of finding their way into the glass vial. In this manner, the interior of the cage became thickly strewn with hairs from the bodies of the adults and with the urticating spines from the last moulted skins of the larvæ, which had been entangled in the cocoons. When cleaning this type of cage or examining its contents, these hairs and spines floated in the air and caused the same affliction as previously described when handling the larvæ. During the last two seasons, the writer found it absolutely necessary to moisten the interior of these cages before working with them. On several occasions, when this precaution was not taken, a severe attack of bronchitis and asthma was the ultimate result.

To illustrate, on one occasion during late October, 1916, at a time when the writer was feeling perfectly healthy and normal in every way, one of these cages was examined without taking the precaution of moistening its contents. Within a few seconds, the air in the vicinity of this open cage became extremely irritating; soon sneezing and coughing began, with excessive watering of the eyes and nasal passages, continuing at intervals until bedtime. The next morning the bronchial region felt sore and contracted (the sneezing had stopped), and great difficulty was experienced in breathing, the same being accompanied by a wheezing noise. The point is again emphasized that this change had taken place within a period of twelve hours. The asthmatic condition grew rapidly worse and necessitated the services of a physician for several days before relief was finally obtained.

Several men connected with the *H. oliviæ* investigations have suffered with these attacks during the past three years, and it has been noticed that each attack appears to be of greater intensity than the preceding one. This tendency will probably render it imperative that susceptible individuals avoid all contact with *H. oliviæ* and, in order to secure immunity or relief in cases of this kind, it may even be necessary to transfer these individuals from that part of the country where

the species exists, as has been found necessary under similar conditions in Brown Tail Moth investigations.

Effects of Urticating Spines on Animals

It was often noticed that small areas of good grazing grass in infested pastures were left untouched by the animals. An examination of these untouched areas generally showed that the grass was infested by the urticating spines shed by the larvæ in the process of moulting. This was evidenced by the fact that upon running the fingers through this grass, the characteristic itching and smarting was experienced. From the facts previously given, the ill effects of these spines on the tender mouth of any animal grazing upon infested grass of this character, can readily be imagined, and it is not strange that the range animals soon learn to avoid all grasses in the vicinity of *H. oliviæ* larvæ. This fact is an important item in the total loss occasioned by the pest.

Urticating Spines of Closely Allied Species

Larvæ of the two closely allied species, *Hemileuca nevadensis* Stretch and *Hemileuca sp.* (*maia* variety ?) Busck, both of which occur in this region, were observed to have the same poisonous properties as have been noted under *H. oliviæ*. The larvæ of *H. nevadensis* feed upon willow along the banks of the Red River in northeastern New Mexico and the larvæ of *Hemileuca sp.* (*maia* variety ?) feed upon scrub-oak along the mesas and foothills of the same region.

Conclusion

From the foregoing, it will be noted that the urticating spines of *H. oliviæ* are a source of danger and discomfort to people coming in contact with the species. The effect of the poisonous agent in these spines appears to be accumulative in its nature rather than to confer any degree of immunity through continual contact.

The injury may be internal or external. The external injury varies in severity according to the part of the body affected, and may lead to partial disability for short periods. The internal injury is more severe than the external injury, and in advanced cases, may result in typical asthmatic symptoms or other disorders of the respiratory tract.

The urticating spines from the moulted skins of the larvæ become scattered through the range grasses and render small areas unfit for grazing.

THE LIFE HISTORY AND HABITS OF CHLOROPISCA GLABRA MEIG., A PREDACEOUS OSCINID (CHLOROPID)

By J. R. PARKER, *Assistant Entomologist, Montana Agricultural Experiment Station*

While a majority of Oscinid (Chloropid) larvæ are vegetable feeders several exceptions to the habit have been noted. Coquillett reared *Gaurax anchora* Loew. from the egg shells of *Corydalis cornutus* Linn. and observed that the larvæ of this species would also feed upon the molted larval skins and chrysalis shells of *Hemerocampa leucostigma* S. & A. He also reared *Gaurax araneæ* Coq. from an egg sac of *Argiope riparia* Hentz. The same worker reared *Madiza oscinina* Fall. from the egg sac of a spider. More recently Jones[1] has described a new species, *Botanobia darlingtoniæ*, the larvæ of which feed upon dead insects caught by the California pitcher-plant (*Darlingtonia californica* Torr.).

While the scavenger habit is apparently quite well developed in the Oscinidæ, to the best of the writer's knowledge no species in the family has been reported heretofore as predaceous. An account of the habits of *Chloropisca glabra* Meig. showing that the larva is predaceous upon the sugar-beet root louse (*Pemphigus betæ* Doane) is, therefore, of interest not only on account of its economic importance but because it records a habit new to this important group of insects.

The development of the predaceous habit within the vegetable feeding family Oscinidæ is forecasted by the exceptions noted above. Larvæ of *Gaurax anchora* feed upon molted insect skins; larvæ of *Botanobia darlingtoniæ* advance closer to the predaceous habit by feeding upon the dead bodies of insect victims of the pitcher-plant; by killing its own victims, *C. glabra* goes one step further and become truly predaceous. It is also possible to conceive that the predaceous habit in this last species has been comparatively recently acquired. When the species was first evolved it may have fed upon the roots of the host plants of *Pemphigus betæ;* later it may have developed a liking for cast skins and the bodies of fungus killed aphids which it would meet continuously among the host plant roots; once having acquired a taste for the body contents of the underground aphids it would have been a very simple matter to include within its diet the slow moving, living root louse with which it was so closely associated.

[1] Jones, Frank Morton. Two insect associates of the California pitcher-plant, *Darlingtonia californica*. Entomological News, v. 27, no. 9, p. 389-392, 1916.

Historical

Very little has been written concerning the life history of *C. glabra*. In Europe Kühn[1] in 1887, found caraway plants attacked by mining insects and reared *C. glabra* from puparia found in the ground below the plants. He apparently infers that the larvæ mining the leaves were of the same species as the puparia taken from the soil. Several notes on the larval habits of *Chlorops assimilis* Macq. now considered a synonym of *C. glabra*, are given by Coquillett[2] as follows: "On July 26, 1884, Mr. Theo Pergande found two larvæ and one puparium of this insect among a colony of aphids on the roots of *Poa pratensis*. One of the flies issued on the 31st of the same month." "On September 6, 1892, several sugar-beets were received from the W. B. Sugar Company, of Castroville, California, and in the leaves were found a number of the puparia of this insect. The adult flies issued two days later." "Larvæ and puparia of this species were taken September 1, 1897, by Messrs. F. H. Chittenden and F. C. Pratt in the earth about the roots of horse radish in the vicinity of Tennallytown, D. C. Several adults issued a few days later."

To Professor J. M. Aldrich, who is making an extensive study of the Oscinidæ (Chloropidæ), I am indebted for the statement that while *C. glabra* is a very abundant species throughout this country and occurs in Europe, Africa and South America, little is known concerning its life history.

In the fall of 1908 Professor R. A. Cooley found puparia of a dipteron in sugar-beet root-louse colonies at Bozeman and he suggested in the original record note that it might be an enemy of the root louse. Adults emerged the following spring and were identified by Coquillett as *Chlorops assimilis* Macq. (*C. glabra*).

Throughout the study of the sugar-beet root louse which was undertaken as an Adams project in 1909, larvæ and puparia of *C. glabra* were found in abundance during the late summer and fall in root-louse colonies and it was suspected from the beginning that it was predaceous upon the root lice. In hundreds of field observations, however, we were never able to actually see the larvæ attack living lice nor feed upon dead lice and as no other member of the Oscinidæ was known to be predaceous, we hesitated to class it as a root-louse destroyer without more definite knowledge. In 1916 a detailed study of *C. glabra* was undertaken,[3] the results of which are embodied in this paper.

[1] Kühn, Julius. Separat Beiblatt des Berliner Tageblatt, No. 9, p. 265, 1887.

[2] Coquillett, D. F. On the habits of the Oscinidæ and Agromyzidæ reared at the United States Department of Agriculture—Division of Entomology. Bul. 10, new series, p. 70–72, 1898.

[3] Mr. A. L. Strand, a careful student assistant, was in charge of the rearing experiments. He devised the improved rearing cage and made many of the observations recorded in this paper.

Rearing Methods

To obtain eggs, adults reared from puparia and later others collected in the open were enclosed with a potted Chenopodium plant in a large lamp chimney cage. The lamp chimney was at first pressed into the soil and the top covered with a piece of cheese cloth. This did not prove satisfactory as moisture collected on the inside of the chimney in large drops in which the flies were continually getting wet after which they would stick to the glass and finally die. To overcome this the chimney was raised from the dirt on a three inch cylinder of fine brass screening and the top was closed by a square of screening held in place by a small weight which hung down into the top of the chimney. In the brass screening around the base a small hole was cut into which was inserted a piece of glass tubing plugged with cotton. This cage allowed air to circulate freely, prevented moisture from condensing on the inside of the chimney, and provided an easy way of introducing adults without disturbing those already in the cage. The screen at the top could be very easily removed and there was no danger of the breaking of elastic band or slipping of string as sometimes happens with cheesecloth coverings.

Eggs were hatched and larvæ were reared in round tin boxes one and one-half inches in diameter and one-half inch deep. These were half filled with plaster of Paris, which provided a smooth, velvety, moisture retaining surface. Several sprouting Chenopodium seeds, five large sugar-beet root lice and one maggot were generally placed in each box. The small rootlets sent out by the sprouting seeds were fed upon by the root lice, which in turn were fed upon by the maggot. The contents of each box were examined daily under the binocular microscope and additional root lice added to bring the number up to five. A few drops of water added to the plaster of Paris each day kept the seedlings growing and brought about moisture conditions in the box closely approaching conditions found in moist soil.

First Appearance of Adults

The adults emerge from overwintering puparia during May and early in June. The earliest appearance noted was on May 19, 1915, when newly emerged adults were seen in a sugar-beet field at Edgar, Montana. On May 22, 1911, large numbers were seen crawling about on the surface of the ground in a sugar-beet field at Bozeman. The field had been soaked by recent rains and the day was warm and bright, conditions which seem to hasten the emergence of the adults. When the newly emerged adults reach the surface of the ground their wings are unexpanded and they crawl about for some time before becoming able to fly.

In the spring of 1916, 360 puparia were collected from the soil in a sugar-beet field and placed in small rearing cages. Some were placed in a green-house and others were kept out-of-doors. Those in the green-house began to emerge on May 27, the period of emergence continuing about a week. Those placed outdoors began to emerge on June 3 and continued to appear in small numbers until June 14, on which date thirty emerged. Only two or three emerged in the cages after this date. On June 15 adults were abundant outdoors, five specimens being taken in the first six sweeps of a net over lawn grass. On this date a search was made for puparia in the soil, but none could be found that had not emerged.

After emergence the adults seek grassy or weedy places, being especially attracted to those that are slightly shaded. In collecting over lawn grass bigger catches are always obtained in the vicinity of shrubbery and trees. While the majority of the adults remain in the grass and weeds many of them can be seen crawling over the foliage of shrubbery and trees.

Copulation

Copulation apparently does not take place until several weeks after the emergence of the adults. On two occasions hundreds of newly emerged adults were observed for several hours during which time no attempts at pairing were witnessed. Adults were kept under observation in the insectary throughout the season and copulation was not noticed until the first week in July. The flies remain paired for several hours.

Oviposition

Successive lots of adults taken by sweeping lawn grass were introduced into breeding cages throughout the summer in the hope of securing the egg and larval stages. Although the cages were carefully watched no eggs were secured until July 22. On the morning of this date eight eggs were found in the fine dirt in the bottom of a cage in which twenty-five adults had been introduced the previous day. An effort was immediately made to observe egg laying outdoors, but it was not until a week later, July 29, that the egg laying process was witnessed. By crawling on hands and knees it was possible to approach within a foot of a Chenopodium plant upon which several adults were crawling about. After a long period of aimless wandering one of them crawled down around the base of the plant, backed toward a crack in the soil, in which the abdomen was inserted and an egg deposited. She then walked to a lump of dirt upon which she rested for about thirty seconds when the process was repeated. Eight eggs were in this manner placed near the base of the plant and then six were de-

posited in a crevice about two inches away from the plant. Several other females were noticed ovipositing on this date and the process was observed a number of times during the summer. The flies are easily disturbed and much care and patience must be exercised in order to observe oviposition.

The eggs are deposited around the base of sugar-beet plants and *Chenopodium album*. Occasionally an egg is found attached to the stem of the plant, but the great majority are deposited in crevices in the soil. Chenopodium occurs most frequently as isolated plants growing in soil that has been recently stirred or cultivated. Thus in reaching both the sugar-beets and Chenopodium the flies leave the grassy areas where they have been since spring and often fly considerable distances to deposit their eggs.

Ability of Females to Select Plants Infested with Root Lice

The females in selecting plants around which to deposit eggs show remarkable ability in picking out the plants which are infested with root lice. Two Chenopodium plants of the same size and appearance and standing about two feet apart were examined for eggs. Around the base of one plant only one *C. glabra* egg was found while from beneath the other 224 eggs were collected. When the latter plant was dug up an unusually heavy infestation of root lice was found while the roots of the first plant had no lice upon them. To determine whether *C. glabra* females could consistently pick out the plants infested with root lice a number of Chenopodium plants were examined with results as shown in the following table:

Table I. Showing that Chloropisca glabra Eggs Are Deposited in Numbers only upon Plants Which Are Infested with Root Lice

Plant number	No. of *C. glabra* eggs	No. of root lice	Plant number	No. of *C. glabra* eggs	No. of root lice
1	2	None	17	10	Many
2	1	None	18	50	Very many
3	1	None	19	0	None
4	0	None	20	0	None
5	1	None	21	0	None
6	0	None	22	16	Many
7	39	Many	23	1	None
8	3	Few	24	2	None
9	1	None	25	73	Very many
10	224	Very many	26	36	Many
11	5	Many	27	0	None
12	0	None	28	1	Many
13	0	None	29	0	None
14	0	None	30	17	Many
15	0	None	31	61	Very many
16	3	Few	32	0	None

Number of Eggs

Egg laying records of isolated females were not made. Dissections of 30 females having the abdomen filled with well developed ova were made. The least number of eggs found in one specimen was 32, the largest number 64 and the average was 52.

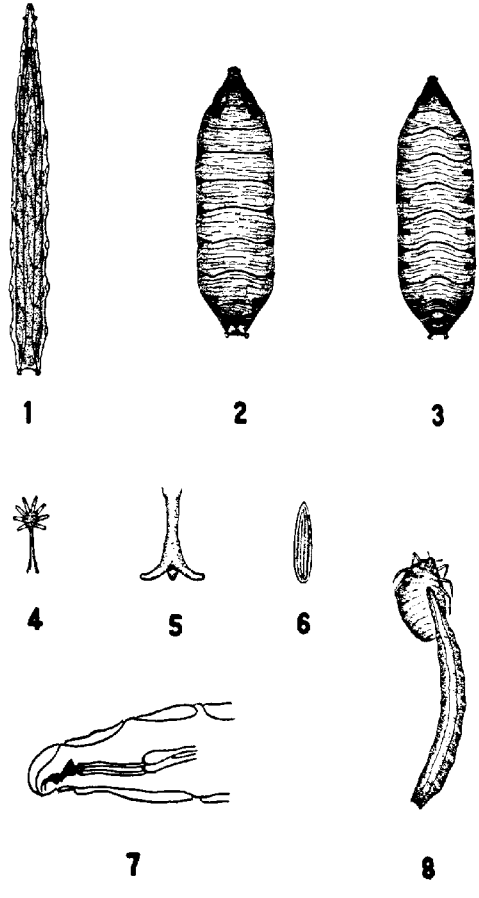

Fig. 14. *Chloropisca glabra* Meig. 1, Larva; 2, Puparium, dorsal view; 3, Puparium, ventral view; 4, Anterior spiracle of larva; 5, Anal spiracle of larva; 6, Egg; 7, Cephalo-pharyngeal skeleton; 8, Larva feeding upon sugar-beet root louse. All figures greatly enlarged.

Description of Egg

Fusiform, more tapering toward the anterior end, slightly curving; rice white; .50 to .75 mm. long and .15 to .20 mm. in width. The chorion is longitudinally grooved and is finely reticulated throughout. The reticulation along the ridges is somewhat coarser and at the posterior end is a much coarser network within which is included a group of finer markings.

Period of Incubation

Two eggs deposited in the breeding cage August 10 hatched August 13; eight eggs deposited August 7 hatched August 12. Eggs collected in the open at various times invariably hatched in 1 to 5 days. The incubation period is, therefore, from 3 to 5 days, and possibly longer during cold, wet weather.

Habits of Larva

The larva upon hatching is a tiny, translucent maggot, about 1.0 mm. in length. In the rearing boxes newly hatched larvæ were not observed to feed until the second day. The maggots are extremely sensitive to light or any disturbance of their surroundings. They will not feed when exposed to light and will stop feeding the moment they are disturbed in any way. This sensitiveness makes it almost impossible to observe their feeding habits in the field and in the hundreds of field observations of root-lice colonies *C. glabra* larvæ have never been detected attacking or feeding upon root lice. When confined with root lice in small, tin boxes, the maggots feed quite readily and by suddenly removing the covers can be seen for a moment in the act. The point of attack is generally on the side of the first segment of the abdomen and more rarely on the ventral surface. The head is inserted well into the aphid and the soft body contents are sucked out. If not disturbed feeding is continued until nothing but the empty skin remains. Only full grown or nearly mature root lice are attacked, possibly because the smaller lice are more active.

Length of Larval Stage and Number of Aphids Devoured

The records of seven maggots hatched from eggs deposited in the breeding cage, reared in tin boxes and supplied with five large aphids per day are shown in the following table:

TABLE II. RECORD OF SEVEN CHLOROPISCA GLABRA MAGGOTS HATCHED AND REARED INDOORS AND SUPPLIED WITH FIVE LARGE ROOT LICE EACH DAY

Serial number	Eggs deposited	Eggs hatched	Number of root lice devoured per day													Total root lice devoured	Length of larval period	Daily average
			Aug. 13	14	15	16	17	18	19	20	21	22	23	24	25			
1	Aug. 7	Aug. 12	1	2	2	3	3	2	3	2	2	1	0	p	p	21	12	1.8
2			0	2	3	2	2	2	2	4	0	4	2	0		23	13	1.8
3			0	1	3	3	2	1	1	3	2	3	3	2	p	27	13	2.1
4			0	1	2	4	3	2	3	2	3	4	4	3	p	31	13	2.4
5			0	2	1	3	2	2	2	3	3	3	0	p		21	12	1.8
6			1	3	4	5	4	2	2	0	p					21	9	2.3
7			2	4	4	5	4	4	5	0	p					28	9	3.1

p=pupated.

The records of six large maggots brought in from the field and supplied with five large aphids per day are as follows:

TABLE III. RECORD OF SIX APPARENTLY MATURE CHLOROPISCA GLABRA MAGGOTS BROUGHT IN FROM THE FIELD AND REARED ON LIMITED FOOD SUPPLY

Larva No.	Number of aphids devoured per day										Total aphids devoured indoors	Total days indoors before pupation	Daily average
	Aug. 8	9	10	11	12	13	14	15	16	17			
1	3	4	3	5	4	2	5	0	0	Pupa	26	9	2.9
2	4	3	4	1	0	Pupa					12	5	2.4
3	0	0	4	2	0	Pupa					6	5	1.2
4	2	0	3	1	4	3	3	Pupa			16	7	2.3
5	5	4	0	0	0	Pupa					9	5	1.8
6	5	3	3	0	Pupa						11	4	2.8

The records of six large maggots brought in from the field and supplied with twenty large aphids per day are as follows:

TABLE IV. RECORD OF SIX APPARENTLY MATURE CHLOROPISCA GLABRA MAGGOTS BROUGHT IN FROM THE FIELD AND REARED ON PLENTIFUL FOOD SUPPLY

Larva No.	Number of aphids devoured per day								Total aphids devoured indoors	Total days indoors before pupation	Daily average
	Aug. 11	12	13	14	15	16	17	18			
1	5	8	7	9	8	10	5	Pupa	52	7	7.4
2	5	6	8	4	8	7	6	Pupa	44	7	6.3
3	6	4	4	5	Pupa				19	4	4.8
4	1	2	6	4	4	1	Pupa		18	6	3.0
5	2	6	6	5	4	Pupa			23	5	4.6
6	2	8	8	1	1	6	Pupa		26	6	4.5

From the above data the length of larval life appears to be quite variable. Larva kept in tin boxes indoors from the time of hatching completed their growth and pupated in from 9 to 13 days while several apparently mature maggots brought in from outdoors continued to feed indoors for 9 days before pupating. The length of the larval period in the field probably varies from 10 to 20 days.

The number of aphids devoured by a single maggot apparently varies according to the supply and accessibility of the aphids. Three maggots were able to complete their growth and pupate on a food supply of only 21 large aphids per maggot, while another maggot after it was apparently full grown consumed 52 aphids! It is probable that maggots under natural conditions in root-louse colonies where food is always within their reach would each consume as many as 75 aphids.

Description of Larva

The larva when full grown averages 6.5 mm. in length when alive in normal position. After being killed by dropping in hot water the body becomes distended and averages 7.2 mm. in length. From its greatest width of .7 mm. at the ninth and tenth segment, the body tapers to .5 mm. at the posterior end and to .2 mm. at the anterior end; it is sharply truncated posteriorly; segmental divisions are marked by faint transverse striæ. The anal spiracles are prominent, extending 1 mm. above body surface, three armed, each arm having a distinct opening. Anterior spiracles smaller, only slightly raised above surface of body, seven branched. Connecting the anterior and posterior spiracles are two large tracheal trunks, which can be easily seen through the body wall, and which are bridged by a cross trunk on the last body segment. The black cephalo-pharyngeal skeleton consists of two heavily chitinized rods ending in sharp, strongly curved hooks. A joint in the rods just behind the base of the hook allows freedom of motion.

In color the larva varies from white to a very pale yellow, depending somewhat on the contents of the alimentary canal.

Pupation

The first signs of approaching pupation are inactivity and a shortening of the body. The larval skin is not shed but becomes the outer covering of the puparium. When the puparium is first formed it is white in color and through its transparent wall the tracheal trunks can still be seen. In a short time the color changes to yellow, then to a light tan and finally to a deep brown. Pupation is completed about 36 hours after the larva begins to shorten.

Length of Pupal Period

The pupal period generally extends from some time in August or September until the following May, a period of about nine months, but a few individuals may emerge during the same season in which the puparia are formed, remaining in the pupal stage only two or three weeks. The following table shows the length of the pupal stage in five overwintering and five fall-emerging puparia:

Table V. Showing Length of Chloropisca glabra Pupal Stage

Serial number	Pupated	Emerged	Length of pupal stage
1	Aug. 17	May 29	282 days
2	Aug. 13	May 28	285 days
3	Aug. 15	June 2	287 days
4	Aug. 12	June 3	291 days
5	Aug. 13	May 29	286 days
6	Aug. 14	Aug. 30	16 days
7	Aug. 14	Aug. 31	17 days
8	Aug. 9	Aug. 29	20 days
9	Aug. 13	Aug. 31	18 days
10	Aug. 12	Sept. 1	20 days

Description of Puparium

The puparia average 5 mm. in length and 1.25 mm. in width. Both the posterior and anterior spiracles are present in practically the same form as in the larval stage. The surface of the puparium is grooved by wavy transverse lines. The thoracic and abdominal segments are indicated by deeper grooves in which the coloring is decidedly darker. Along each side are seven narrow, oval depressions, occurring at the segmental divisions and enclosed by dark brown lines.

Hibernation

C. glabra hibernates as a puparium in the soil where the larva completed feeding. The puparia become increasingly abundant during late August and September and by the last of October no other stage can be found. Repeated examinations of root-louse colonies in the late fall and early spring have failed to give evidence of hibernation in any form other than the puparium. A large proportion of the puparia hibernate successfully. Out of 360 puparia collected early in May, 266 or 74.4 per cent, transformed to adults.

Seasonal History

The adults emerge from overwintering puparia during a period extending approximately from May 15 to June 15. Adults are abundant in the open from June 1 until late in September. During the last of August they become scarce in lawn grass but are abundant in the vicinity of sugar-beets and Chenopodium.

In 1916 the first eggs were found in the breeding cage July 22, and outdoors July 29. Eggs were plentiful throughout the month of August. On September 5, only empty egg shells could be found and dissections of females indicated that egg laying was practically over. Out of 25 females examined on this date only 2 contained eggs.

Larvæ were first observed indoors on July 25 and outdoors August 2. In observations of sugar-beet root-louse colonies during the last seven years the maggots have never been noticed in abundance in the field until the middle of August.

The larvæ were at the height of their abundance during the last week of August. Practically all the larvæ had pupated by September 21, although several maggots were found during the month of October.

The first puparia were obtained indoors August 12 and outdoors August 21. On the latter date upon examining the crowns and roots of Chenopodium plants all stages of the fly were found; eggs about the crowns; all sizes of larvæ and occasional puparia among the roots. From this date the number of puparia gradually increased. During the first week in September about as many puparia as larvæ could be

found but from this time on, the number of puparia rapidly increased until September 21, when practically nothing but this stage could be found. None of the puparia obtained in the breeding boxes during August emerged until the following spring.

All of our studies carried on in 1916 indicate that at Bozeman *C. glabra* is single brooded. However, in repeating part of the rearing work in 1917 it was found that in that year at least, a partial second brood occurred.

On August 8 and 10 fifty newly transformed puparia were collected from about the roots of Chenopodium growing in a compost heap. By August 28 forty-five adults had emerged.

Twenty-six puparia were also collected on August 10 from about the roots of Chenopodium growing in ordinary soil. From these three adults emerged September 2. The remaining puparia appear to be perfectly normal and are being held in an outdoor rearing cage.

Fifty large maggots were collected on August 11, isolated in rearing boxes and each supplied daily with 20 root lice. At the end of seven days 42 had transformed to puparia and 8 had died. By September 2 five adults had emerged; the remaining puparia all seem to be alive and apparently will pass the winter in this stage as did all the individuals reared in 1916.

With the above exceptions, *C. glabra* is considered as single brooded at Bozeman. The main reasons in support of this statement are as follows:

1. Adults continue in about the same numbers throughout the summer, disappearing gradually during September.

2. Larvæ never appear in abundance until August and always diminish rapidly during September.

3. Puparia do not reach their maximum abundance until September.

4. Puparia collected at any time during one season seldom emerge until the following spring.

5. Females which emerge in the fall have the ova only slightly developed. Considering that females which emerge in May do not lay eggs until July it does not seem probable that the few adults which may emerge about September 1 could reproduce before being killed by the fall frosts.

In warmer sections of the country, and at lower altitudes it is quite probable that *C. glabra* is double brooded. This is indicated by Coquillett's rearing notes already referred to.

Economic Importance

C. glabra in Montana is by far the most effective insect enemy of the sugar-beet root louse (*Pemphigus betæ*), which in turn is the worst pest with which the sugar-beet growers of Montana have to contend.

Hundreds of puparia have frequently been found in the soil around a single sugar-beet which means that large numbers of root lice have been destroyed. The larva is particularly efficient in that it concentrates its efforts on destroying only well developed root lice, thus preventing the birth of young root lice that would soon increase to enormous numbers. It is not uncommon to find a large number of puparia in the soil around a sugar-beet plant with only the empty skins and secretions of the root lice to indicate their former abundance.

It is certain that *C. glabra* larvæ act as a very important check upon the increase of sugar-beet root lice and in many instances destroy entire colonies.

NEW GALL MIDGES (DIPT.)

By E. P. Felt, *Albany, N. Y.*

The species described below comprise some unusual forms, especially the presumably predaceous *Mycodiplosis packardi*, which closely simulates the associated *Retinodiplosis albitarsis*, the latter with a most interesting larva. The types are in the New York State Museum.

Allomyia n. g. The presence of circumfili, toothed claws, a third vein uniting with costa at the apex of the wing, triarticulate palpi and thirteen antennal segments, indicates a relationship with Cystiphora Kieff., from which the genus can be easily separated by the absence of a terminal spine on the short ovipositor. Type *A. juniperi* n. sp.

Allomyia juniperi n. sp. The one female issued June 12, 1918, from a package of apical, burr-like galls on Juniperus received June 5, 1918 from Ivan M. Way, Oxford, Colo.

The gall is a small, apical, burr-like deformity with a diameter of 5 mm. It differs from the larger rosette galls in that there are no distinctly reflexed leaves.

Female. Length 1.5 mm. Antennæ extending to the base of the abdomen, sparsely haired, mostly yellowish and reddish, thirteen sessile segments, the fifth with a length two and one-half times its diameter, a subbasal irregular whorl of long, stout setæ and at the basal third and apically low, fine, indistinct circumfili. Terminal segment produced, with a length over three times its diameter, the apex subacute. Palpi: first segment rectangular, the second quadrate, the third narrowly oval, the second and third with a series of stout, spiny processes apically. Mesonotum dark brown, almost black. Scutellum dark reddish brown, margined with dark brown. Postscutellum dark yellowish orange. Abdomen dark brown, the short ovipositor yellowish orange. Wings hyaline, subcosta uniting with the anterior margin near the basal half, the third vein, strongly curved distally, at the apex of the wing, the fifth probably forked. Halteres pale yellowish. Legs mostly pale straw, the distal portion of tibiæ and the tarsi dark reddish. The one claw on the posterior leg of the specimen is unusually stout, strongly curved, unidentate and the pul-

villi is greatly produced, having a length nearly thrice that of the claw and a width greater than the length of the claw. Ovipositor short, the lobes broad, roundly truncate and thickly clothed with short, stout, spiny hairs. Type Cecid. a 2921.

ASPHONDYLIA DONDIÆ n. sp. The male described below was reared from deformed leaves on sea blite, *Suæda* or *Dondia multiflora*, collected by Professor E. Bethel, April, 1918, at Point Fermine, Calif. It is related to *A. vernoniæ* Felt and *A. ceanothi* Felt from which it is most easily separated by color characters and variations in the length of the third antennal and palpal segments.

The gall is a blackish, globose, sessile, leafy deformation with a diameter of 3 mm.

LARVA. Length 1.75 mm. Stout, yellowish orange, head short, broad, antennæ short, broadly triangular, biarticulate, the terminal segment with a length nearly equal to its diameter. Breastbone quadridentate, the anterior portion with a width nearly double the posterior part, skin coarsely shagreened, posterior extremity broadly rounded.

EXUVIUM. Length 3 mm. Moderately stout, reddish brown and with characteristicly developed rows of spines on the dorsum of the abdominal segments.

MALE. Length 3.5 mm. Antennæ nearly as long as the body, sparsely haired, dark brown, fourteen segments, the third with a length five times its diameter. Terminal segment with a length about four times its diameter and tapering slightly to a broadly rounded apex. Palpi, first segment short, broad, the second about one-half longer than the first, the third more slender, fourth nearly as long as the third. Mesonotum dark brown, the submedian lines thickly clothed with long, white hairs. Scutellum yellowish brown with exceptionally long, whitish hairs. Postscutellum reddish orange. Abdomen dark reddish brown, sparsely clothed with yellowish hairs. Wings almost subhyaline, the membrane with a fuscous tinge. Halteres reddish orange, fuscous subapically. Coxæ dark brown, legs mostly dark straw, the tarsi nearly black. Claws rather slender, strongly curved, the pulvilli a little shorter than the claws. Genitalia; basal clasp segment short, stout, terminal clasp segment greatly reduced, almost unidentate, dorsal plate short, broad, broadly and triangularly emarginate, the short lobes partly rounded. Ventral plate short, broadly and roundly emarginate, the lobes acute, both plates thickly setose. Type Cecid. a 2892.

THECODIPLOSIS COCKERELLI n. sp. The gall of this insect, or at least one nearly indistinguishable therefrom, was received from Glen Eyrie, Colorado Springs, Colo., through Professor T. D. A. Cockerell, in December, 1907. Specimens were received from Ivan Way, Oxford, Colo., from which a female was reared in 1918. The species is probably generally distributed in Colorado at least.

The gall is an irregular, kidney-shaped enlargement of the needles of *Pinus edulis*. It has a length of 7 mm., a diameter of 4 mm.; the walls are thick and the needles rudimentary.

FEMALE. Length 1.75 mm. Antennæ extending to the base of the abdomen, sparsely haired, fuscous yellowish, fourteen segments, the fifth with a stem one-fourth the length of the cylindric basal enlargement, which latter has a length two and one-half times its diameter. Terminal segment somewhat reduced, the basal enlarge-

ment with a length twice its diameter and apically a short, knob-like process. Palpi; first segment irregularly oval, stout, the second a little shorter, more slender, the third a little longer than the second, and the fourth slender, more than twice the length of the third. Mesonotum, scutellum and postscutellum yellowish brown. Abdomen yellowish orange. Halteres whitish transparent, legs mostly pale straw, claws of the hind legs at least, long and moderately stout, strongly curved, the pulvilli a little longer than the claws. Ovipositor when extended nearly as long as the body, distinctly chitinized, subaciculate. The distal portion is rather stout, strongly striate and apically with approximate, triangular, finely dentate lobes, each bearing at the distal fourth two diverging spike-like spines. Type Cecid. a 2822.

MYCODIPLOSIS PACKARDI n. sp. The male of this species was reared June 20, 1918, from a white pine (*Pinus strobus*) branch one and one-half inches in diameter infested with *Parharmonia pini* Kell. The exuded masses of pitch were inhabited by midge larvæ, some of which remained in the pitch, transformed therein and produced adults described as *Retinodiplosis albitarsis* n. sp. There were other larvæ which emerged from the pitch mass and formed cocoons either on the twigs or the bottom of the tree and it is apparently from these other larvæ that this species was reared. The habit of deserting the pitch and making cocoons upon the food plant appears to be identical with that described for *Cecidomyia pini-rigidæ* Packard and there is a possibility that the two are identical, though this cannot be determined with the data available.

COCOON. Length 5 mm., diameter 2 mm. Moderately stout, mostly indistinctly rounded, the pointed apex presenting the appearance of a rather short, stout, waxy process.

MALE. Length 3 mm. Antennæ probably nearly as long as the body, rather thickly haired, fuscous yellowish, fourteen segments, the fifth almost trinodose with stems one and one-fourth and twice their lengths respectively. Basal enlargement globose, the distal enlargement, strongly constricted near the middle with a length almost twice its diameter, the loops of the circumfili moderately numerous and with a length greater than the diameter of the enlargement. Terminal segment having the basal portion of the stem with a length one-half greater than its diameter, the distal enlargement so strongly constricted near the basal third as to suggest two partly adherent spheres and apically a short stem bearing a small subglobose appendage. Palpi; first segment quadrate, the second with a length twice the first, the third slender and with a length one-half greater than the second and the fourth as long as the second, slender. Mesonotum dark brown, with moderately thickly haired submedian lines. Scutellum and postscutellum dark brown. Abdomen sparsely haired, dark brown. Wings subhyaline, the membrane thickly clothed with fuscous hairs. Halteres yellowish basally, fuscous apically. Coxæ fuscous yellowish. Legs mostly dark brown. Claws long, slender, rather strongly curved, the anterior unidentate, the pulvilli about one-half the length of the claws. Genitalia; basal clasp segment rather long, stout; terminal clasp segment a little longer than the basal, slender. Dorsal plate short, very deeply and triangularly emarginate, the lobes narrowly triangular and sparsely setose apically. Ventral plate moderately long, broad, deeply and roundly emarginate, the lobes rather broad, narrowly rounded apically and with a stout seta at the tip. Style long, stout, narrowly rounded apically.

This species runs in the key to *M. emarginata* Felt, from which it is easily separated by both colorational and structural characters. It presents a remarkable similarity to Retinodiplosis with which it is evidently associated and upon which it may prey. The two species, under a hand lens, appeared almost indistinguishable, except that the Mycodiplosis was somewhat smaller. The color characters of this midge are partly conjectural. Type Cecid a 2917 a. Named in honor of Doctor A. S. Packard, one of the first American Entomologists to study the gall midge fauna of our pines.

RETINODIPLOSIS ALBITARSIS n. sp. A series of both sexes was reared in June, 1918, from a white pine (*Pinus strobus*) branch one and one-half inches in diameter, infested with *Parharmonia pini* Kell. The exuded masses of pitch were inhabited by midge larvæ which transformed therein and produced large sized, dark colored adults with very constant, striking tarsal markings. The very similar *Mycodiplosis packardi* was also reared, the larva of this latter apparently deserting the pitch masses prior to transforming. This Retinodiplosis has the general structural and color characters of *R. palustris* Felt, from which it is most easily distinguished by the distinct narrow femoral and tibial white annulations and yellowish white distal three tarsal segments of the posterior legs.

MALE. Length 3 mm. Antennæ two-thirds the length of the body, fuscous yellowish or dark brown, fourteen segments, the fifth having stems as long and one-half longer than their diameters respectively, the basal enlargement subglobose, the distal enlargement with a length one-fourth greater than its diameter, vasiform. The circumfili with moderately long, rather abundant stout loops. Terminal segment produced, the basal stem with a length twice its diameter, the distal enlargement produced, with a length over twice its diameter and apically with a small conical appendage. Palpi; first segment short, irregular, the second with a length three times its diameter, the third a little longer than the second, the fourth nearly as long as the third and somewhat dilated apically. Mesonotum dark reddish brown, the submedian lines thickly haired. Scutellum dark brown, apically thickly clothed with yellowish scales. Postscutellum reddish brown. Abdomen sparsely haired, deep reddish brown, genitalia fuscous. Wings thickly clothed with short, dark hairs, subfuscous. Halteres yellowish basally, fuscous subapically, whitish apically. Coxæ dark brown, femora basally fuscous yellowish, subapically fuscous, narrowly annulate with white apically. Tibiæ dark brown, narrowly annulate with white apically. Tarsi dark brown except the yellowish white distal three segments of the posterior legs. Claws moderately long, slender, curved, the pulvilli a little shorter than the claws. Genitalia; basal clasp segment moderately long, stout; terminal clasp segment rather short, stout; dorsal plate deeply and triangularly incised, the lobes irregularly triangular and narrowly rounded apically. Ventral plate rather long, moderately broad and tapering to a broadly rounded apex. Style long, stout, broadly rounded apically.

FEMALE. Length 5 mm. Antennæ extending to the third abdominal segment, sparsely haired, fuscous yellowish, the fifth subsessile, cylindrical, with a length two and one-half times its diameter. Terminal segment somewhat produced, tapering to

a narrowly rounded apex. Mesonotum dark brown, with moderately thick submedian lines of short, silvery scales and with the sublateral areas sparsely clothed with somewhat broader scales. Scutellum dark brown, thickly clothed with silvery scales. Postscutellum dark brown. Abdomen sparsely clothed with fuscous hairs, deep red. Halteres yellowish basally, fuscous apically. Ovipositor probably one-half the length of the body, fuscous yellowish, the terminal lobes yellowish orange. Type Cecid. a 2917.

LARVA. Length 4 mm. Moderately long, stout, strongly segmented, with conspicuous tubercles, the extremities tapering, a variable reddish orange. Head small, subconical, the outer walls apparently slightly chitinized and at the posterio-lateral angles chitinous projections with a length twice that of the head. Antennæ slender, conical. Breastbone irregular, expanded and truncate anteriorly. The lateral and posterior spiracles on tubercles, each supported by a black chitinous, cup-shaped structure; those of the anal pair larger and strongly dentate. Abdominal segments, except the eleventh and twelfth, each with a submedian pair of long, fleshy tubercles, the length approximately one-third the body width, most of them more or less furcate. The lateral tubercles support the spiracles and are about one-fourth the length of the subdorsal tubercles. Ventrally pseudopods are fairly well developed on the tenth, eleventh and twelfth segments, those on the last spine tipped and apparently with the same structure as the subdorsal tubercles.

ONODIPLOSIS SARCOBATI Felt.[1] The male described below for the first time was received May 20, 1918, from Professor Harold R. Hagan, Logan, Utah, and a series of both sexes were reared from bud galls on *Sarcobatus vermiculatus*, the adults issuing directly from the gall after the pupa had worked itself about three-quarters out of the deformity.

MALE. Length 2.5 mm. Antennæ a little longer than the body, sparsely haired, pale yellowish, fourteen segments, the third and fourth free, the fifth having stems each with a length about twice its diameter; the basal enlargement subglobose with a sparse subbasal whorl of stout setæ and a circumfilum with moderately short loops; the distal enlargement pyriform, with a length one-half greater than its diameter; a subbasal and subapical circumfilum, each with loops having a length less than the diameter of the enlargement; terminal segment, basal enlargement subglobose, basal portion of the stem produced, slender, the distal enlargement irregular and tapering to an obtuse apex. Palpus consisting of an irregular, tapering setose segment with a length about twice its diameter. Mesonotum dark yellowish brown. Scutellum and postscutellum very dark brown, almost black. Abdomen sparsely haired, fuscous yellowish, genitalia somewhat darker. Wings as in the female. Halteres whitish basally, fuscous yellowish apically. Coxæ dark brown, legs mostly pale straw. Genitalia; basal clasp segment stout, with a length about twice its diameter, terminal clasp segment moderately long, swollen subapically, the chitinous tip pectinate. Dorsal plate long, deeply and triangularly emarginate, the lobes broad, broadly rounded, ventral plate short, broadly emarginate, lobes broadly rounded. Harpes widely separated apically, roundly tapering and sparsely setose. Style short, chitinized apically. Cecid. a 2914.

PUPA. Length 2.5 mm. Head, thorax, antennæ, wing and leg cases all a somewhat variable fuscous yellowish. Abdomen red, smooth.

[1] 1916, Felt, E. P., N. Y. Ent. Soc. Journ., 24: 176.

A NEW CORN INSECT FROM CALIFORNIA (HETEROPTERA)

By CARL J. DRAKE, *New York College of Forestry*

Several weeks ago I received a number of "lace-bugs" or Tingidæ that had been collected upon corn or maize, *Zea mays*, in Grass Valley, California, by Professor Essig. A careful study of this material indicates the species to be an undescribed species belonging to the genus *Corythucha*. Corn is undoubtedly the food plant of this tingid as Professor Essig collected nymphs as well as adults on it and noted the injury to the leaves caused by the feeding of both nymphs and adults.

CORYTHUCHA ESSIGI sp. new. Hood moderately large, abruptly constricted just back of the middle, the length about three times its greatest height, the posterior portion low and highest at the constriction. Paranota moderately broad, reniform, the margins, except anterior ones, destitute of spines. Pronotum punctate; median carina rather low, very slightly rounded at the middle, with a single row of large areolæ, a little longer than the length of the base of the entire hood; lateral carinæ widely separated from the hood, with four or five distinct areolæ. Legs moderately slender. Rostral laminæ with large cells, the rostrum extending between the intermediate coxæ. Elytra rather narrow, the outer margins slightly concave and unarmed or spineless; costal area triseriate or nearly triseriate, the areolæ irregular in size. Wings extending slightly beyond the apex of the abdomen. Claspers strongly curved in the male. Length, 2.8 mm.; width, 1.5 mm.

Color: General color whitish, with a few fuscous markings on the nervures. Nervures of the hood, paranota, and carinæ whitish, except a few nervelets on the hood and paranota fuscous; areolæ hyaline. Elytra whitish, with a transverse band near the base (areolæ very slightly dusky) and a more or less oblique band (areolæ slightly dusky or hyaline) near the apex fuscous; areolæ hyaline. Legs yellowish white, the tips of tarsi dark brown. Body beneath black.

Several specimens, taken in Grass Valley, California, September 7, 1917. This seems to be the first record of a species of Tingidæ that infests corn. *Corythucha distincta* O. & D., has been taken in Montana (Cooley) upon corn, lettuce, parsnip, beans, lupine, turnip, squash and *Balsamorrhiza* and in Utah (Larson) upon *Carduus lanceolatus*. *Distincta* is a very variable species in color, but it is readily separated from *essigi* by its much higher hood, larger size, etc. *Essigi* is probably most closely allied to *obliqua* O. & D. from which it can be readily distinguished by the color pattern, the shape of the hood and median carina. *Obliqua* feeds upon *Ceanothus* and is a very common form along the Pacific slope.

Type in my collection; *paratypes* in collections of Professor Essig and the author.

Scientific Notes

Apple tent caterpillar parasites. Two parasitic cocoons were taken from a nest at Corinth, N. Y., June 23, 1915. The cocoons are about a quarter of an inch long, subcylindrical with rounded extremities, chalky white with black markings as illustrated in figures 7 and 16 on pages 20 and 33 respectively of Technical Series No. 5, Division of Entomology, United States Department of Agriculture. The cocoon is, with very little question, that of *Amorphota orgyiæ* How., while the parasite which was reared from the cocoon proved to be *Otacustes periliti* Ashm. Both of these species have been earlier recorded as parasites of the white marked tussock moth, *Hemerocampa leucostigma* Sm. and Abb. in the above cited Bulletin.

E. P. Felt.

A Chigger Mite of Chrysopa Larvae. In December, 1917, Mr. Rodger C. Smith, of Milwaukee, Wisconsin, sent us three specimens of larvæ of *Chrysopa rufilabris* to which were attached four larvæ of the Erythræidæ belonging to the genus Erythræus. These specimens were taken August 25, 1917, near the Soldiers' Home, Milwaukee, Wisconsin. Mr. Smith states that they were of a bright red color before being put in alcohol.

This is the first record to our knowledge of a specific parasitic mite of Chrysopa larvæ. The shape of the cephalic shield and the arrangement of the coxal setæ are quite different from that of the larvæ of any American species of this genus. As the adult of this form is not known we hesitate to describe it as new.

Albert Hartzell, *Iowa State College, Ames, Iowa.*

Anthracophaga distichliæ sp. n. Male and female. Pale yellow, subopaque, marked with grayish black on disk of thorax, and brownish black on abdomen and legs. Ocelli surrounded by a black spot; triangle with a dark brown streak from posterior lateral angle to or a little beyond the middle on each side, and a central stripe from anterior extremity to midway to anterior ocellus; third antennal joint black; arista fuscous at base, yellowish beyond; palpi fuscous, pale basally. Thoracic dorsum with five opaque black vittæ in fresh specimens, the lateral pairs abbreviated anteriorly; a very distinct pale oval spot on middle of lateral margin above and between the notopleural bristles; humerus with upper half black; anterior spiracle glossy black; sternopleura, mesopleura, pteropleura, hypopleura and metanotum largely black; scutellum with a large black spot on each side. Dorsum of abdomen black-brown, each segment with a narrow yellow posterior margin, which projects in the form of a short wedge anteriorly at middle. Legs variable in color, usually with femora and hind tibiæ brownish on middle. Wings grayish, veins brown, slightly clouded. Halteres white.

Frons over half the head-width; triangle very large, occupying nearly the whole width of vertex, and extending to anterior margin, the sides convex; entire frons including triangle, with short, black, setulose hairs; face in profile slightly concave, retreating below; antennæ small, third joint as broad as long, slightly angulate on upper side at apex; arista tapered, with microscopic pubescence; eyes about 1.5 as high as long; cheek rugose, coarsely so posteriorly, half as high as eyes, with numerous short, black hairs; thoracic dorsum with short, setulose, decumbent hairs; mesopleura with a few weak setulose hairs posteriorly; scutellum with six marginal bristles and numerous discal hairs. Abdomen with hairs like those of thorax. Legs normal,

stout. First costal division slightly longer than second, the latter nearly twice as long as third; last section of fourth vein about five times as long as preceding section.

Length, 3.5–4 mm.

Type locality, Long Beach, Cal., July 7, 1916, reared in the New York State Museum from a bract-covered gall on *Distichlis apicata* collected by Prof. E. Bethel.

This species is allied to *declinata* Becker but that species differs essentially in color and structure of head.

J. R. MALLOCH.

Codling Moth Activities at Time of Total Eclipse. The writer observed the activities of the codling moth during the period of the sun's eclipse, June 8, 1918, at Hood River, Oregon. The notes were taken in the Experiment Station orchard. This particular insect is quiet during the daytime, engaging itself in mating and egg laying at twilight and continuing on into the night if temperatures are sufficiently high. The effect of this unnatural darkness upon the insects was therefore watched with interest.

At Hood River totality was reached at 4 o'clock. At 3.47 light became sufficiently subdued to cause the insects to take wing. They immediately began to seek out favorable locations upon which to deposit eggs and an insect was observed depositing an egg at 3.50. This was followed by the deposition of two others shortly thereafter, following which it became too dark to observe further activities and this particular moth was lost sight of. Moths were noted on the wing until 4.15 after which it apparently became so light that the inclination for further egg laying left them. Egg laying was noted as taking place normally at 8 o'clock in the evening of this date.

The temperature during the half hour between 3.45 and 4.15 dropped exactly 10° F., or from 86° F. to 76° F.

The rapidly diminishing light and temperature had a very decided influence upon all insect life. The day was particularly favorable for general insect activities, being both quiet and warm, with many flowers in bloom. Many species of bees and flower flies were on the wing and the hum of the insects in their flights was distinctly audible. As darkness approached the flights of the insects almost instantly ceased and with it the hum of their busy wings. The death-like quiet which followed for a few moments due to this added further to the strangeness of the scene. Several species of bees, Syrphids and Tipulids were noted at rest on apple foliage as the sun's light began to establish itself.

LEROY CHILDS,
Entomologist and Plant Pathologist, Hood River Experiment Station.

Culicidæ of Colorado. Through the kindness of Prof. C. P. Gillette, we have been permitted to examine the Culicidæ in the collection of the State Agricultural College. The specimens do not bear the names of collectors, but most, at least, appear to have been obtained by Mr. G. P. Weldon. There is one species new to the state, *Aedes cinereus* Mg., three from Estes Park, July 11, 1912. One of these had already been determined by Mr. Knab. The *Anopheles quadrimaculatus* from Hotchkiss appear to have the pale bands on thorax better defined than in eastern specimens, and more material may indicate a subspecies. The following are new records from localities from which we already had some material:

DELTA. *Aedes curriei*, 20 ♀, *A. vexans* 1 ♀, all July 18, 1911.

ESTES PARK. *Aedes samsoni*, 9 ♀, July 11 and 16. Also 18 ♀ apparently *A. pullatus*, but none perfect.

GRAND JUNCTION. *Aedes nigromaculis*, 22 ♀, July 12 and 27; *A. curriei*, 18 ♀, July 12, 13, Aug. 10; *A. vexans*, 14 ♀, May 24, July 14, Aug. 30. It appears that

vexans comes on early and late in the season, with the maximum of the other two species between.

HOTCHKISS. *Culex tarsalis*, Aug. 29.

The following localities are new:

ARKINS (Larimer Co., 5,224 ft.). *Aedes vexans*, Aug. 3.

FORT COLLINS (Larimer Co., 4,984 ft.). *A. nigromaculis*, June 13, 18, Aug. 14; *A. curriei*, small females, Aug. 17; female with dark markings of abdomen lacking, May 31.

GUNNISON (Gunnison Co., 7,673 ft.). *A. curriei*, bad condition but apparently this, June 25; *A. aldrichi*, several, June 25. The latter are not in very good condition, but agree with *aldrichi;* one had already been determined by Knab.

LOVELAND. *Aedes* sp. too poor.

MONTE VISTA (Rio Grande Co., 7,653 ft.). *A. curriei*, 7 very poor specimens, Aug. 20.

PALISADE (Mesa Co., 4,729 ft.). *A. curriei* and *A. vexans*, Aug. 11.

STERLING (Logan Co., 3,932 ft.). 14 *A. curriei* and 3 *A. nigromaculis*, July 31.

T. D. A. COCKERELL and JOHN T. SCOTT.

Notes on Eleodes tricostata Say. After the publication of the most able article on *Eleodes tricostata* Say, by James W. McColloch, in the April issue of this magazine, the following notes may be of interest. Early in March, complaints came to this office concerning a new cutworm. Investigation showed this to be the larva of *Eleodes tricostata*. These complaints increased up to April 25 and since have gradually decreased. With a few exceptions, every county from Wilbarger on the north to Jim Wells on the south, and from Callahan east to the state line, report the presence of this worm in destructive numbers. In fact, more complaints were made in March, April and May about this insect than all others combined. The work of the larva somewhat resembles that of the true cutworms, but the larva will also climb large plants and cut off buds and leaf stalks. It works very heavily on radishes, cabbage, onions, tomatoes, potatoes, corn, cane and almost everything else in garden or field.

Most gardeners were satisfied with the results obtained from the use of poisoned bran mash, Paris Green giving better results than arsenate of lead. The adults are extremely plentiful this year. They may be found in old or heavily pastured fields, where from two to a dozen or more will be found under each pile of dry manure. This has given many gardeners the notion that this cutworm was brought into the garden with barnyard manure. The adults have a very peculiar habit of sunning themselves on ant hills during the warm days of winter. There must be some vital connection between this beetle and the agricultural ant, as adult Eleodes are more abundant near the ant hills than elsewhere. The larva works at night and on cloudy days. Because of its voracious appetite and omnivorous habits, it has been dubbed the Kaiser worm by the war gardeners of central Texas.

H. B. PARKS,
Extension Entomologist, A. and M. College, College Station, Texas.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

AUGUST, 1918

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Contributors are requested to supply electrotypes for the larger illustrations so far as possible. Photoengraving may be obtained by authors at cost. The receipt of all papers will be acknowledged.—EDS.

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Two of our comrades have passed on. They have made the supreme sacrifice gladly. Their example urges us to greater effort. They realized that the better part of life is service. Let us render them all possible honor and join in grateful recognition of their efforts. Young in years, strong of heart, undaunted in spirit, they gave their all. None can do more. We sorrow at the parting and rejoice that so noble a cause should have taken them from us. May each of us heed the call of duty in an equally devoted spirit.

Entomologists are not primarily soldiers and yet the practise of their calling, the successful control of insects, may have a most vital effect upon military success. A striking case is the Macedonian campaign and the pernicious type of malaria prevailing in connection therewith. Preventive doses of quinine apparently failed, malignant tertian malaria prevailed and hemoglobinuria was frequent.

The following significant figures are from the British Medical Journal of March 23, 1918. In the British Army in one region during January about one man in 1,000 was evacuated weekly to the base with malaria. The number then rose steadily until in the third week of May about one in 130 (about 7.6 in 1,000) had to be evacuated. From July until into September, the rate was 1 in 55 (about 18 in 1,000). There was a rise in mid-September and the maximum for the year was reached the second week of October when the rate was 33 in 1,000. Some specially exposed units had almost if not absolutely all their personnel infected at the same time and in a few cases as much as one-third of the strength of the unit had been evacuated to the hospital within a month during the height of the malarial season. These figures are for 1917 and represent conditions after continuous anti-malarial work that resulted in a considerable lessening of the number of cases as compared with the previous year.

Obituary

JOHN W. BRADLEY

Lieutenant John W. Bradley of the Aviation Branch of the United States Army, met with an accident July 2nd at Wilbur Wright Field, Dayton, Ohio, which resulted in his death two days later. Lieutenant Bradley was a graduate of the Massachusetts Agricultural College and had been employed several years as a Scientific Assistant in the Bureau of Entomology, and worked at the Gipsy Moth Laboratory, Melrose Highlands, Mass. He enlisted as a Cadet in November, 1917, received ground training at the Massachusetts Institute of Technology and Princeton University, after which he was ordered to Wilbur Wright Field for instruction in flying. He completed this course and received his commission as Lieutenant about a month ago, and after a few days furlough was appointed instructor. The accident happened while Lieutenant Bradley was flying with a Cadet. The machine fell about 150 feet. The injuries which he sustained were so serious that he died two days later.

A. F. B.

VERNON KING

With deep regret attention is called to the death of Lieutenant Vernon King, formerly Scientific Assistant in the branch of Cereal and Forage Insect Investigations, Bureau of Entomology, United States Department of Agriculture. Lieutenant King was at one time attached to the staff of the Wellington, Kans., field laboratory and was afterward placed in charge of the station at Charleston, Mo. He resigned from the service November 5, 1914, for the purpose of entering the British Army, and proceeded to Canada with this idea in view. For some reason he was not admitted to the Canadian troops and went to England where he gained an appointment in the service for sea duty. For some time he was stationed at the Dardanelles but more recently had become a member of the flying corps and the last direct news received from him stated that he was flying in the vicinity of Verdun. The press account of his death, which is in the form of a letter from his Commanding Officer, Maj. C. F. A. Portal, addressed to Lieutenant King's father, states that while serving as a flying observer on April 11, 5.20 p. m., his plane was attacked by three enemy scouts and shot down. Lieutenant King lived for about one-half an hour but did not regain consciousness. During Mr. King's term of service in the Bureau of Entomology he made many friends by reason of his genial personality and vivacious disposition. The chief investigations

conducted by him were those on the corn wireworm, *Horistonotus uhleri*, afterwards completed by Mr. E. H. Gibson under the direction of Mr. W. R. Walton, Entomologist in Charge, Cereal and Forage Insect Investigations.

The following is a copy of the letter of Major Portal:

No. 16 Eqn. R. A. F., B. E. F.
April 12th.

Dear Mr. King:

I am extremely sorry to have to tell you that your son, Lieut. V. King, was killed in action in an air fight yesterday, April 11, at 5.20 p. m.

He was flying as an observer to Captain Jones, the most experienced pilot in the Squadron and they were attacked and shot down by three enemy scouts. Your son put up a great fight, firing 250 rounds at the hostile machines, but they could not cope with odds of three to one for long, and were eventually shot down. Your son lived for about one-half hour, but never regained consciousness.

We are extremely sorry to lose him, as he was very popular with all ranks of the Squadron. Always keen and cheerful, he set a splendid example to everyone, and did much to keep up the high spirits which this unit has always shown.

We brought his body in last night and he will be buried by the side of his pilot and many other brave men from this Squadron at Aubigny, near here, on the road from Arras to St. Pol.

Please accept on behalf of the whole Squadron our deepest sympathy in your sad loss.

Yours very sincerely,
(signed) C. F. A. PORTAL (Major),
35 Whitehill Road, Graves Ent.

Current Notes

Mr. A. K. Pettit of the Dallas, Texas, laboratory of the Bureau of Entomology has enlisted in the Coast Artillery.

Mr. Ottomar Reinecke, who has published lists of Coleoptera, of Buffalo, N. Y., died November 26, 1917, aged seventy-seven years.

Mr. E. H. Gibson of the Bureau of Entomology has been commissioned a lieutenant in the Sanitary Corps of the United States Army.

According to *Science*, Dr. W. D. Funkhouser (Cornell) has been appointed head of the department of zoölogy at the University of Kentucky.

The degree of Doctor of Laws (LL.D.) was conferred upon Surgeon-General William C. Gorgas by New York University at its recent commencement.

Mr. A. C. Lewis has been appointed state entomologist of Georgia in place of E. L. Worsham, whose resignation was announced some time ago.

Professor John H. Comstock of Cornell University lectured before the Syracuse Chapter of Sigma Xi, April 1, on the Habits of Spiders.

Professor H. T. Fernald of the Massachusetts Agricultural College has returned to Amherst after a six months' leave of absence spent in the Southwest.

Mr. J. E. Eckert has been appointed assistant entomologist in field work and nursery inspector in the Station, vice S. C. Clapp, at the North Carolina Station.

Dr. F. W. Pettey of Cornell University, has resumed his duties as entomologist for Cape Province, South Africa. His address is Elsenberg Agricultural College, Mulders Vlei, Cape Province, South Africa.

George S. Demuth and E. F. Atwater of the Bureau of Entomology, held a series of meetings in California in the spring, the subject being the control of European foul brood.

Professor George G. Becker, state entomologist of Arkansas, has resigned his position to enter the military service of his country. His address for the present is 502 North Calhoun St., Baltimore, Md.

Mr. Charles E. Sleight of Paterson, N. J., a collector of insects, and member of the New York and Brooklyn Entomological Societies, died at Ramsay, N. J., May 20, 1917, aged fifty-seven years.

Professor A. C. Burrill, formerly state entomologist of Idaho, has been appointed special field agent, Bureau of Entomology, to assist in extension work on cereal and forage insect control in Washington and Oregon.

Dr. Paul S. Welch, Kansas Agricultural College, is a member of the zoölogical staff of the Biological Station of the University of Michigan at Douglas Lake; the tenth session extends from July 1st to August 23d.

Dr. E. P. Felt delivered an illustrated lecture on "Garden Insects — good and bad—" May 19th at the Brooklyn Botanic Garden, this being one of a series of "Win-the-War-Gardens" lectures inaugurated for Sunday afternoons at four o'clock.

Professor C. L. Metcalf, professor of Economic Entomology at the Ohio State University, Columbus, Ohio, is spending the summer in Ithaca, N. Y., where he has charge of the course in general biology in the summer session of Cornell University.

Mr. W. H. Goodwin of the laboratory of Economic Zoölogy, Harrisburg, Pa., has accepted a position with the state entomologist of New Jersey and is in charge of eradicating the Japanese beetle, *Popilia japonica* Newman, an infestation of which was discovered last year at Rutherford, N. J.

Mr. Reyne, who is on his way from Holland to take a position as government entomologist in Dutch Guiana, spent about a month in the United States in June and July visiting the Bureau of Entomology and the Agricultural Experiment Stations at College Park, Md., New Brunswick, N. J., and New Haven, Conn.

According to *Entomological News*, the deaths of the following European entomologists are announced: Dr. Emile Frey-Gessner, Geneva, Switzerland (particulars not given); William Henry Harwood, English Lepidopterist and Hymenopterist, born

February 25, 1840, died December 24, 1917; Richard S. Standen, English Lepidopterist and artist, born October 11, 1835, died July 29, 1917.

Mr. Irving W. Davis, for five years assistant to the state entomologist and deputy in charge of gipsy moth work in Connecticut, has been granted a leave of absence, dating from July 1, 1918, to enlist in the Marine Corps. During his absence the field work will be in charge of Mr. John T. Ashworth.

A hearing was held on May 28, before the Federal Horticultural Board at Washington, D. C., relative to restricting or prohibiting the importation of nursery stock from foreign countries. Some entomologists present were: F. C. Lewis, Georgia; Franklin Sherman, Jr., North Carolina; W. J. Schoene, Virginia; J. G. Sanders, Pennsylvania; T. J. Headlee, New Jersey; W. E. Britton, Connecticut, and A. G. Ruggles, Minnesota.

A meeting of the Massachusetts Tree Wardens' Association was held July 11 and 12, several points in Massachusetts being visited. Some entomologists present were J. M. Swaine and J. B. McLaine of Canada; Professor G. W. Herrick, Cornell University, Ithaca, N. Y.; W. E. Britton, state entomologist, New Haven, Conn.; A. F. Burgess, L. H. Worthley, D. M. Rogers and C. W. Collins of the Bureau of Entomology.

The New York Entomological Society celebrated its twenty-fifth anniversary, June 7, 1918, by holding a special meeting at the Hotel Colonial, 81st Street and Columbus Ave., New York City. The program included a history of the Society, reminiscences by Mrs. Annie Trumbull Slosson, Mr. Henry Bird and others, and remarks by guests representing sister societies, among whom were Dr. Henry Skinner and Mr. J. A. G. Rehn of the American Entomological Society of Philadelphia.

Dr. Carlos Moreira of Rio de Janeiro, Brazil, chief of the Bureau of Agriculture of the National Museum, and commissioner of the Department of Agriculture of Brazil, visited the Bureau of Entomology for two or three days during March. Dr. Moreira was in this country as a special commissioner with many assignments. He was able to spend only a very small part of his time with the entomological force of the bureau.

The following resignations from the Bureau of Entomology are announced: J. S. Stanford, fruit insect extension work, Idaho; C. W. Cartwright, assistant, Knoxville, Tenn., to enter the army; C. E. Bartholomew, apiculture; G. C. Mathews to return to commercial beekeeping in Idaho; C. P. Trotter, Mound, La., to enter the Naval Hospital Service; Scott Johnson, cereal and forage insect extension work, Kansas, to enter the navy; H. N. Gellert, truck crop insect extension work, Florida; S. W. Frost, truck crop insect extension work, New York, to accept a position with the Pennsylvania State College; P. B. Miles, alfalfa weevil investigations, Salt Lake City, Utah.

Mr. A. E. V. Richardson, of the Department of Agriculture at Victoria, Australia, visited the Bureau of Entomology on May 20th. He is looking into the bureau organization of the United States Department of Agriculture and the general subject of agricultural organization and coöperation in the United States, with extreme care. The Federation of Australian States is investigating the desirability of bringing about a federal agricultural service, and all of the problems connected with such an organization are under careful investigation. The different colonies in Australia have developed strong departments of agriculture with an entomological service in each one. The old problem of "States' Rights" is naturally more confusing out

there with the new federation than it is in the United States or even in South Africa. In the latter case there has been not simply a federation, but a much more centralized organization.

Announcement has been made of transfers in the Bureau of Entomology as follows: W. H. Foster, Washington, to Oregon; A. J. Ackerman, Benton Harbor, Mich., to Bentonville, Ark.; J. J. Culver, Monticello, Fla., to Fort Valley, Ga.; H. G. Ingerson, Sandusky, to Cleveland, Ohio; R. B. McKeown, Brownwood, Tex., to Medford, Ore.; H. K. Plant to Seaview, Wash., in charge of laboratory for investigation of cranberry insects; Marion R. Smith, Baton Rouge, La., to Plymouth, Ind.; O. K. Courtney, Gainesville, to Glen St. Mary, Fla.; Thomas H. Jones, Baton Rouge to New Orleans, La.; Frank R. Cole, truck crop insects to cereal and forage insect investigations, Northwestern States; F. B. Milliken, New Orleans, La., to Amarillo, Tex.; G. H. Gale, Washington, D. C., to apicultural extension work, Wisconsin; A. L. Ford, Wellington, Kans., research laboratory, to cereal and forage insect extension work, Kansas; D. C. Parman, extension work on insects affecting domestic animals, Texas to Louisiana; R. H. Hutchinson, investigations of the body and head louse, New Orleans, La.; J. U. Gilmore, tobacco insects, South Boston, Va.; F. L. Chamberlain, tobacco bud worm, Quincy, Fla.

Appointments to the Bureau of Entomology are reported as follows: R. W. Kelly, Ohio State University, special field agent, fruit insects, Lafayette, Ind.; A. B. Black, Oregon Agricultural College, special field insects, Corvallis, Ore.; Charles A. Weigel, New Hampshire College, Federal Horticultual Board; Miss Emily S. Reed, Cornell University, scientific assistant, tropical and subtropical insects; E. G. Baldwin, apicultural extension work in Indiana, Ohio and Michigan; Felix Dabadie, truck crop insects, Louisiana; Max W. Reeher, special field agent, cereal and forage insect extension work, Pacific Northwest; B. G. Thompson, cereal and forage insect extension work, Oregon and Washington; George H. Rea, special field agent, apicultural extension work, New York; D. A. Davis, apicultural extension work, Iowa; William A. Hoffman, Cornell University, scientific assistant, insecticides; Leo C. Antles, Colorado Agricultural College, scientific assistant codling moth experiments, Grand Junction, Col.; Dr. Oscar H. Basseches, United States College of Veterinary Medicine, scientific indexer; Eugene L. Prizer, University of California, special field agent, citrus insects, California and Arizona; Charles Batchelder, truck crop insect, extension work, Maine; Perry W. Fattig, special field agent, cereal and forage insect extension work, North Dakota; C. K. Fisher, special field agent, cereal and forage insect extension work, Colorado; H. R. Painter, cereal and forage insect investigations, Charleston, Mo.; L. G. Gentner, truck crop insect, extension work, Wisconsin; J. G. Griffith, cereal and forage insect extension work, New Mexico; Marshall Hertig, cereal and forage insect extension work, Minnesota; G. J. Hucker, cereal and forage insect extension work, Nebraska; H. E. Jaques, cereal and forage insect extension work, Iowa; Clay Lyle, truck crop insect extension work, Mississippi; A. D. Tilton, fruit insect extension work, Massachusetts; Roger Smith, corn ear worm investigations, Charlottesville, Va.; A. H. Hollinger, Columbia, Mo., cereal and forage insect investigations, College Station, Tex.; E. O. G. Kelly, extension entomologist, Kansas scouting for Oriental peach moth—E. D. Brown, William M. Robinson, R. P. Allaman, J. H. Smith, V. A. Roberts, E. T. Rannells, H. B. Pierson, H. S. Saidel, C. H. Alden, J. H. Boyd, and A. F. Vierheller.

Mailed August 16, 1918